SCIENCE

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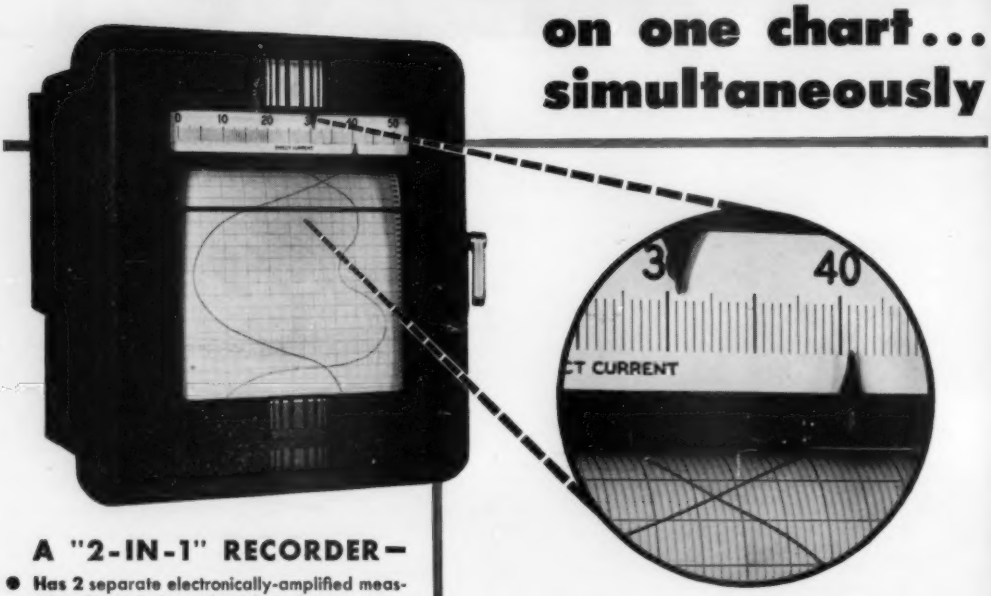

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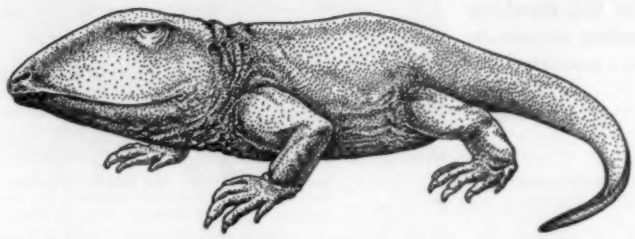

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[1] Although he may have been connected in some small way with the invention of the amniote egg.

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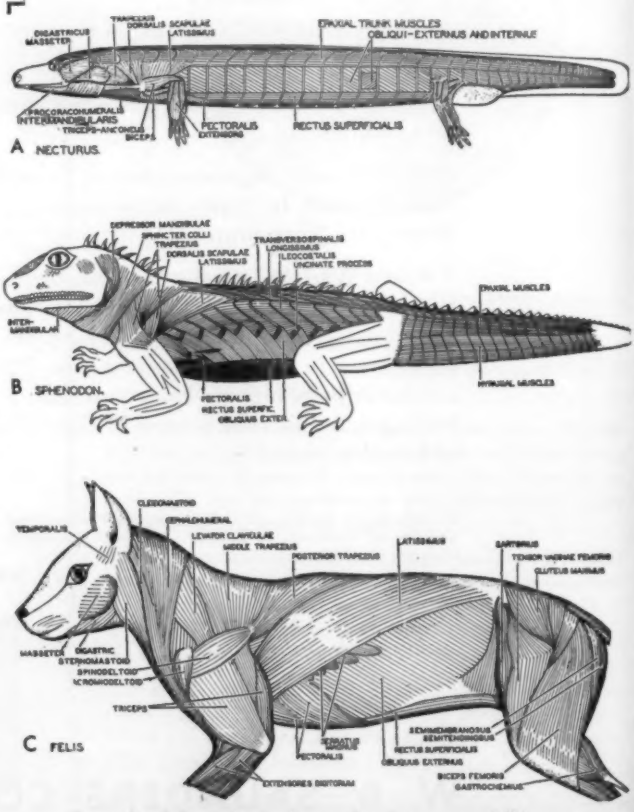

Superficial lateral trunk-muscles in an amphibian, a reptile, and a mammal. From Rand's "The Chordates".

Gladys M. Keener
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Earth Sciences

The meteorological data collected near the Marshall Islands during Operation Crossroads in 1946 led Professor Palmer and his co-workers to hope that changes in atmospheric motion and composition which usually go undetected in the sparse observing network normally maintained in the tropics could be analyzed, described, and understood. These hopes are being justified. It has been shown that the conventional ideas of atmospheric circulation in the subequatorial zone are unrealistic. The equatorial circulation is dominated by a broad easterly current overlapping the surface low-pressure trough, and this current is the vehicle of a long train of atmospheric waves moving westward, which extend over the breadth of the tropical Pacific Ocean and grow in amplitude until they finally break into vortices that stagnate seasonally over Australia or southeastern Asia to form a "monsoon low." A certain small proportion of these vortices intensify rapidly and become typhoons. Understanding of basic atmospheric processes, obtained through intensive study of abundant observational data applying to selected time sequences, may well lead to improvements in techniques of weather prediction in other regions.

During the past two years observations of the periodic tidal fluctuations of gravity, throughout periods of several weeks to several months, have been made at UCLA, Pasadena, Honolulu, Attu, and Lake Tahoe. In the Los Angeles area, a major feature of the earth's response is a phase lag of about 80 minutes. The amplitude of the gravity fluctuations is about 132 per cent of that theoretically expected on a rigid earth—a result in general accord with observations of others. An interesting regional difference in the earth tides is found in the failure of the Honolulu results to exhibit the simple correlation with the primary excitation forces, clearly revealed at the Southern California stations. Regional variations in the earth's response to the tide-producing forces will be investigated.

The plastic behavior of marble under high confining pressures has been known through laboratory studies for about fifty years. Quantitative explanations of the processes that accompany and permit large strains in solids have, however, been unsatisfactory or lacking. Recent work by Griggs, Turner, and Handin furnishes an understanding of the major processes involved in the deformation of Yule marble. Literally, the deformations may be both seen and understood, since the petrographic microscope, and the transparency of thin sections of marble, are essential features in the success of the study. Microscopic observations of the statistics of the orientations of the calcite crystals composing the marble aggregate, first in the natural state, and then after deformation by known stresses, furnished the detailed evidence which required explanation. Two major processes contribute to the yielding of an individual crystal in the aggregate—crystallographic "twinning" on the susceptible $\{01\bar{1}2\}$ plane, and translation on this same plane. Analytic treatment of these processes has resulted in correlation of the anisotropic plasticity of the aggregate (as experimentally observed under compression and extension in the test laboratory) and its initial statistical crystal orientation. Increased temperature and the addition of water reduce the strength of marble markedly without apparently altering the mechanism of deformation. This program, designed to further understanding of deformation in the earth's crust, is also adding to knowledge of the plastic behavior of crystalline solids in general.

LOUIS B. SLICHTER

Institute of Geophysics
University of California
Los Angeles

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GENETICS IN THE 20th CENTURY

L. C. DUNN
Editor

This book is a collection of the papers presented at the Jubilee Meeting of the Genetics Society of America in September 1950. The papers were prepared for the meeting by leading authorities in the field of genetic research. *To be published in April*

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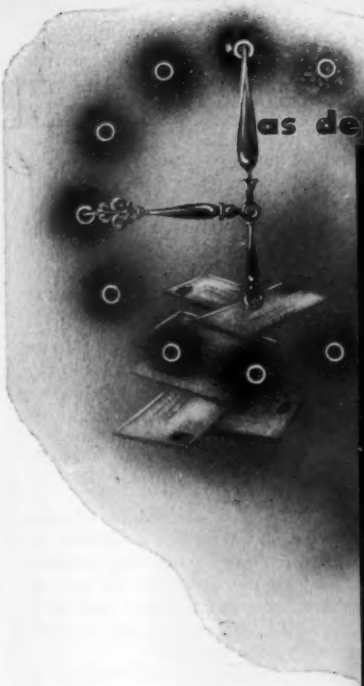

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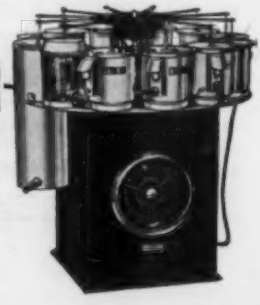

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Air Conditioning Department

HEAT PUMP: The trend toward complete year-round air conditioning of residences as well as larger buildings has focused increased attention on the heat pump. Since 1932, when the residential heat pump was first being investigated in this country, 750 heat pumps have been installed in the United States; 60 per cent of the installations are in residences and 40 per cent are commercial. Heat pumps are currently being installed at the rate of approximately ten per week. . . .

The functions of year-round air conditioning provided by heat pumps include heating in winter, cooling and drying in summer, air filtering, circulation, and ventilation. These functions are accomplished electrically, under automatic control, without combustion, and without fuel in the ordinary sense.

The basic principle is the same as is used in a common electrically operated refrigerator. A simple illustration of its operation can be obtained by imagining that a refrigerator with its door removed is placed against an open window. Then heat removed from the outdoor air by the refrigerator evaporator is dissipated from the condenser into the house. For cooling, the refrigerator could be placed outside the house against the same open window. Then heat removed by the evaporator would be pumped outdoors. Of course the domestic refrigerator is not designed for this application; its capacity would be much too small, and its operating economy for this type of operation would be low. . . .

Although it is still early to obtain a clear-cut picture of what the future holds for the heat pump, it appears to be entering a period of rapid growth, and heat pumps for year-round air conditioning in homes and other buildings will be appearing in greatly increasing numbers. . . .

It is sometimes refreshing, even if premature, to exercise the imagination by looking further into the future. In one conception of a "dream" version heat pump, the heat pump is combined with some of the multitudinous equipment which our living standards demand in a single factory-produced package. Such a unit would serve as a complete utility core for the house and would provide a source of hot and cold water, conditioned air the year round, and heating and cooling for the associated appliances. Heat that is pumped from the freezing and cold storage compartments would be used to help heat the air and domestic water. Heat that is otherwise wasted in the kitchen exhaust and for evaporating moisture in clothes drying could be largely recovered. The heat pump, thereby, may serve some day as the central unit of the all-electric home.

General Electric Review
December, 1950

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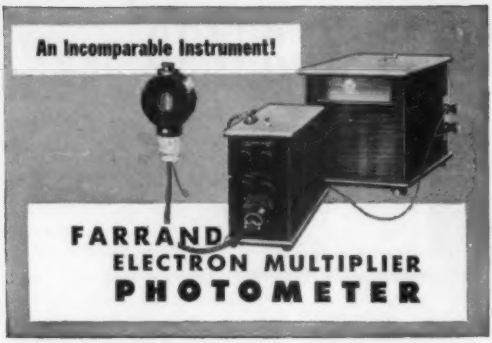

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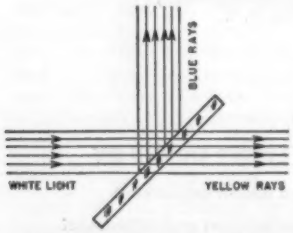

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Report on a Collection of Birds from Guerrero, Mexico. Emmet R. Blake. Vol. 31, No. 39. Nov. 1950. 25¢; ***Report on a Collection of Birds from Oaxaca, Mexico.*** Emmet R. Blake. Vol. 31, No. 40. Chicago Natural History Museum. Nov. 1950. 25¢.

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Anais de Instituto de Medicina Tropical. Vol. VI. Lisbon, Portugal. Dec. 1949.

Directory American Institute of Mining and Metallurgical Engineers, Inc. Sect. two. American Institute of Mining and Metallurgical Engineers, Inc., New York. Nov. 1950.

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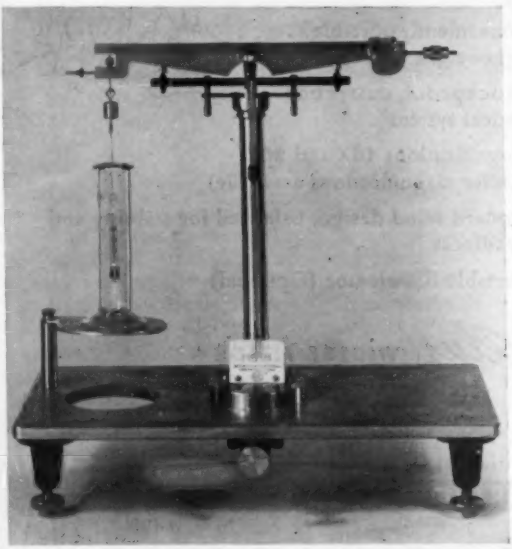

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SCIENCE, according to Conant's definition, falls into the category of accumulative knowledge. If in a given period no new facts have been found and no new concepts developed, science has been at a standstill. At the same time, however, a number of facts and concepts may have been drawn from the stockpile of pure science into the field of application. Even while not standing still, science is forever feeding on its own earlier-produced results and may thereby drain its stock. This means that the question as to the scientific progress made in a given period cannot be answered simply by enumerating new facts and concepts. Scientific progress is a dynamic concept; it is essentially an increase in potentialities. It cannot, therefore, be measured in terms of simple accumulation of new and fruitful concepts but as the rate at which this accumulation increases.

So we see that promoting scientific progress is not only a matter of preserving the *status quo* in effort, number of scientists, and financial and material resources. Even if today comparable results could be reached with the same number of men and quantity of apparatus as yesterday—which is impossible as long as the complexity of problems on hand is growing—real progress would demand ever-increasing supplies of competent personnel and of funds. Disregarding for the moment the question of personnel, it is already obvious that, even in the most prosperous of times, there is a limit to the amount of money that can be spent on scientific research. Consequently progress as defined above is essentially discontinuous. In its ideal form it can only be approached in times of heavy pressure, such as when the public suddenly realizes the danger to itself from cancer or other threats, or during a war.

Science—pure science—is like a beautiful woman, wooed by many suitors for her enchanting charms; and like other delicate ladies, she is apt to swoon when courtship grows too vehement. In time of war or other emergency that is what happens, even though it is not really she who is courted, but her more practical sister (or is it daughter?), applied science, who actually thrives under the many attempts to win her favor.

Nevertheless, in situations like these, when stress is laid on applicability and technology, there are some bright spots for pure science. Young people are drawn toward a scientific career; large-scale facilities are made available that can eventually be used for basic research. Public attention is drawn toward science; inertia, if nothing else, will leave the purses open for some time after the emergency has ceased to exist. Either so much fundamental knowledge will be used up, or, in certain fields, lack of basic knowledge will become so evident, that not only the scientists but perhaps even the general public and a number of the responsible authorities may become apprehensive. And so, after the heyday of science seems to be over, a flourishing of a somewhat different kind may begin.

Continually growing resources being impossible to realize, the assumption will have to be made that there are other ways of creating persistent stimuli. Farsighted marshaling and ingenious switching about of limited means may result in a constant tackling of new problems. If it is true that in this way a first approximation can be reached of what is needed, even small and impoverished nations may hope to bring about some scientific progress if they are prepared to shoulder the necessary—substantial but finite—financial burden, and if they have the men who can find the ways to be followed.

Wartime fertility in the family of scientific organizations, as witnessed in the United States during earlier wars by the birth of the National Academy of Sciences and the National Research Council, seems to be a universal phenomenon. In a record number of countries World War II has been responsible for the creation of councils for scientific research and science foundations. Just now the happy event has taken place in the Netherlands. The newborn Organization for Pure Scientific Research will be described here, but, before going into its history and aims, mention must be made of its elder sister the (Netherlands) Central Organization for Applied Scientific Research.

This, too, had its origins in wartime. During the first world war the Royal Netherlands Academy of Sciences took the initiative in creating an agency to coordinate the national effort in applied science. The government was haphazardly catering to its own research needs, often without really understanding them; and industry, lacking research-mindedness and, to a large extent, too small to finance separate laboratories, was—with a few notable exceptions—doing very little or nothing at all. It took many years for the idea, first suggested by the academy led by Lorentz, to crystallize. Not until 1931 was final agreement reached, and a law was adopted setting

up the organization which is now generally known as "T. N. O."

Two decades after its creation, T.N.O. is now a closely knit network of some fifty institutes, laboratories, field stations, and research groups. The Central Organization itself is divided into a number of special organizations for, e.g., industrial, agricultural, defense, and—the newest addition—health research. Each special organization has its council, consisting of both scientists and industrialists or others concerned with the application of science in the economic or social life of the nation. The chairmen of these councils sit together on the board of the Central Organization T.N.O., where they again can rely on the advice of a council made up of citizens prominent in either science or industry and economy.

Financially, too, T.N.O. has twofold support. A large part of its expenses are met by an annual government subsidy; the smaller but still considerable part is contributed by organized industry for general support and for special research contracts. Close cooperation among government, scientists, and industry is guaranteed in this way, and many fruits have already been born, of high value in the present period of growing industrialization of the country. Even in a geographically small country like the Netherlands it has been found worth while to pay special attention to the location of many of the institutes: the leather research institute, for example, is in the region where most of the leatherworks are, etc.; and several of the laboratories are situated near, and even in, universities with parallel interests.

As already mentioned, the initiative for the Organization for Applied Scientific Research was taken by "pure" scientists, like physicist Lorentz and botanist Went, not in the first place by industrial or "applied" scientists. It is in a way highly significant that the initiative for the Organization for Pure Research came from application-minded men like Kruyt, present board chairman of T.N.O., and Holst, then director of Philips Research Laboratories.

As in many other countries, after World War II the Bush report in the Netherlands met with wide response. Faced with the seemingly impossible task of mending its war-devastated economy, its altering relations with Indonesia pressing for a total reorientation in the financial and industrial sphere, the country's leaders saw only one way out: industrialization and still more industrialization. Practically without natural resources, heavy industry and mass production of semimanufactured articles fell beyond the scope of the country's possibilities. High-quality products and refining of imports seemed to be the only foundation on which recovery of the Netherlands could be based. This again could only be realized if industry had at its command the very best research facilities and the ablest scientists. Here the Bush report pointed the way: applied science can only flourish and stay flourishing if basic science is steadily feeding it with its newest results. And so the phrase was coined that only one kind of products could put Holland on its feet again: brain products.

What is the present state of the resources for these products? The past has been rather favorable. Eight Nobel prizemen is not a bad record for a country whose land area is less than that of Connecticut and Massachusetts put together, and whose rapidly growing population only a few months ago reached the ten million mark. But . . . the last of these got his award in 1929. Is it presumptuous to ask why eight in thirty years and none in the next twenty? There may, of course, be nothing in this. The occurrence of a van der Waals, a van't Hoff, or Einthoven is far too rare a phenomenon to yield to statistical computation. But let us for a moment assume that there is something symptomatic about it, what can the reasons be? Decrease in intellectual capacities? Deterioration of educational methods? Perhaps. But there are other causes that might account for the difference. The most obvious of these is the enormously increased competition. At the beginning of the century Western Europe practically held the monopoly of an activity that by now is widely practiced in every civilized country in the world. But must we not look deeper? May it not be that the days are over that a man like Kamerlingh Onnes could sit back in a dilapidated building and, with less than modest material aid, reach temperatures far lower than had ever been dreamed of? May it not be that, even if creative thinking still can only be done by the individual, individualism is no longer an advantageous attribute of the scientist but an impediment to teamwork? It certainly is true that many problems in modern science, and those the most fundamental, are so complex that the cooperative effort of many specialists is needed to solve them. As in many other phases of life, in scientific research specialization and integration must go hand in hand. May it not be that Dutch science lags behind in methods of integration, even though it may produce good specialists?

We shall not try to answer these questions. For insiders in Dutch university life it is easy to see that, if a serious attempt is made to bring science in Holland back to its former flourishing self, all these points will have to be taken into account. The financial position of the country being what it is, the most economical and efficient use must be made of available funds. This also makes coordination necessary. Here again we meet the difference between applied and pure science. Sturdy as applied science is, it may react favorably to the more coercive forms of coordination, whereas pure science, even if it is impossible to get results without cooperation and teamwork, will always be so highly dependent on the individual, free to follow his own line of thought, that coordination in pure scientific research is a tool to be used with great restraint and the utmost care. It appears that, to achieve this kind of coordination, not only is extensive knowledge of the research field in question necessary, but also a perfect understanding of the motivating

forces that regulate the behavior of the scientist at work. This means that the coordinating body must preferably be made up of scientists.

Funds large enough to accomplish the desired results can at the moment be found only in the public treasury; hence a form of organization has to be found where nearly all active decisions can be made by scientists while at the same time the government can be responsible financially and politically to the people for those decisions. Before explaining how this problem has been solved in the Netherlands, one more important aspect must be brought forward.

Why is public support for science justified? The community has not the *"l'art pour l'art"* interest, the scientific curiosity, the wish to understand what to many a scientist is still the prime moving force. Research is desirable to the community solely because of its services. So, the question arises, which fields of science can contribute to the public weal? Not overlooking the demonstrable fact that one field may contribute more, and certainly more directly, than another, the answer that has been given to this question in Holland is simply: "All." And this means much more than the use of the English word science implies. In Dutch, as in German, *scientia* has been translated by a word that has retained the original Latin meaning. *Wetenschap* includes the natural and social sciences, as well as the humanities. It may be that this semantic difference has something to do with an analogous difference in appreciation of the part that the *Geisteswissenschafte* play in the life of a people.

If it is important to understand nature in its physical and biological expression, isn't it of as much consequence to understand social phenomena? And isn't it even more fundamental to understand the working of the human mind? In our times social structures are rapidly changing. Man has continually to adapt himself to his surroundings. To do this in such a way that his life is dignified and worth living while the *Naturwissenschafte* aid him in making an optimal use of his material resources, he needs at the same time the help of religion, philosophy, pedagogy, sociology. The study of philology, linguistics, history, psychology, ethnology, etc., are essential in trying to get some understanding of the functioning of the human mind. All these *Wetenschappen* are at least as important to the community as the natural sciences. They deserve just as much attention when active efforts are made to stimulate science.

Obviously the humanities will have to be treated in a different way than the physical or medical sciences. Both in their financial requirements and in the need for coordination there is a large disparity. This might be thought sufficient reason for a total separation. On the other hand, there are many who think that the crucial trouble of the modern world lies exactly in the divergence between the two large fields of knowledge. Disregarding the one while trying to propagate the other will merely cause the situation to deteriorate. Only total integration of effort can ultimately result in the balance between sciences and humanities which, to many, seems so important for the future.

II

On January 5, 1950, after a long parliamentary procedure, a law was passed setting up the *Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek* (abbreviation: Z.W.O.; translation: "Netherlands Organization for pure 'scientific' research"). Z.W.O. can be distinguished from the Science Foundations in several other countries, on the one hand, by the catholicity of its interest in the "sciences;" on the other hand, by its limitation to pure research where "pure" is meant as the antonym of applied.

To understand the position of government, universities, and scientists in the organization, a little must be said about all three. According to the Dutch constitution, each cabinet minister can be held accountable by Parliament for all his actions. He may have to answer for the way in which funds are spent that have been appropriated on his budget, as well as for the application of laws that have been countersigned by him or his predecessors. As the Z.W.O. Act bears the countersignature of the Minister of Education, Arts, and Sciences, and the state support to the organization appears on this minister's budget, there must be some provision that he can carry responsibility for the actions of Z.W.O. However, scientific freedom from political influences is so traditional in Holland that the possibility of placing the management of the organization in other hands than those of scientists has never even been raised. Even in the state universities of Leiden, Utrecht, and Groningen, where professors are appointed by the government, the influence of the Minister of Education, though of vast importance financially, never leads to political nominations. Recommendations by the Senate (the assembly of all full professors) carry such weight that the Board of Curators very seldom dissents—and this for purely academic reasons and only if such disagreement exists the minister will feel free to reject a recommendation. Scientists, as in most Western countries, have no union. There is a young Federation of Scientific Workers, but this has not yet reached so large a membership that it may be called representative. Science has its only official representation in the Royal Netherlands Academy of Sciences with its two divisions for *Natur-* and *Geisteswissenschaft*. In all scientific matters this venerable institution ranks highest and acts as the official government adviser.

Z.W.O. consists of four separate organs: the Council on pure scientific research, the Board of the organization, the advisory committees, and the Director and his bureau. Of these the council is the top organ. It consists of two representatives of each of the universities: one for the sciences, one for the humanities and the social sciences. In each university the Senate and the Board of Curators together draw up a list of recommendations, and, acting on the advice of the Royal Academy, the Minister of Education appoints the members in such a way that not only the uni-

versities but also, as far as possible, the different branches of learning are represented. In addition to these there are council members from nonuniversity circles (at present: two industrialists, one leader of agriculture, the president of the Supreme Court, and the president of the National Bank). The council is the general policy-making body. It decides directly only on the most important issues, but it lays down the principles along which the board can take action.

The board consists of six members chosen by and from the council, including *ex officio* its chairman and vice chairman. This board is the real governing body. Board and council chairman for the first five-year term is G. Van der Leeuw, noted theologian and philosopher, and a former Minister of Education, Arts, and Sciences; the vice chairman is H. B. Dorgelo, physicist of the Technische Hogeschool at Delft. They are appointed by the minister from binding nominations of three names made by the council.

In addition to those already mentioned, there is another member of both council and board. This is the representative of the Minister of Education, Arts, and Sciences. He has the same rights and obligations as the other members and, in addition, a kind of veto power. He may order the suspension of any decision that he thinks will be contrary to the interests of the country or the wishes of the government. This suspension is strictly limited in time. The Minister of Education must then either raise the suspension or make it permanent. He is, however, legally obliged to ask the Royal Academy to advise him. It will be clear that all possible precautions are taken to ensure the scientific standpoint a fair hearing. This right of suspension will probably only have significance as a preventive against rash or insufficiently founded decisions. It is interesting to note that a similar veto right in the organization T.N.O. has never been used since the beginning in 1931, but neither the government nor the T.N.O. board would like its abolition. The government representative and his suspension right ensure the necessary ministerial responsibility without opening the door to management of Z.W.O. by the Administration.

The director is not a member of board and council, but acts as their secretary. He is at the same time the organization's business manager and is free to make any suggestion he deems appropriate to board or council. The board appoints and removes him. He attends all meetings of the advisory committees. These have been established for the physical, biological, and medical sciences, and for the humanities and the social sciences; their number may be enlarged. No research grants may be made without consultation of one of these committees, which have liberty to make recommendations *proprio motu*. Members of these so-called fixed committees are appointed each year by the Council, with the advice of the Royal Academy. These committees, their subcommittees, and *ad hoc* advisers are the real scientific arm of Z.W.O. and its most important organ.

III

Several years lie between the original plans of 1945 and the Act of 1950 creating Z.W.O. Happily this lapse of time was not paralleled by lack of action. The impulse that set the government in motion also resulted in vigorous activity among scientists. An association of the country's nuclear physicists—in some ways comparable to "Brookhaven"—cooperatively using a cyclotron and coordinating atomic researches in the universities; and a mathematical center, combining the efforts of many mathematicians and designing and building modern electronic calculators, were among the institutions that came into being long before Z.W.O., although they were destined eventually to fall into its sphere of activity. The government, on the other hand, did not sit back to wait until organizational and legislative difficulties had been smoothed out but, immediately after it had become clear in which way plans were developing, appointed a preliminary board of the not yet existing organization and made funds available for initial activities. Although these funds were small, this made it possible to make a number of research grants as early as 1946. Appropriations have been growing; before the middle of 1950 four million guilders[1] had been used. This may not seem a large sum compared with U. S. expenditures for research, even though the size of the country is one three-hundredths and its population one fifteenth that of the U.S.A. It goes, however, to basic research exclusively.

Some of the reasons may be mentioned for the organizational separation between T.N.O. and Z.W.O. Applied research usually has definite goals; it may be planned more distinctly and accurately than pure science, which is more dependent on individual preferences and personal interest. Hence applied research may thrive in specialized institutions under managerial direction, whereas pure research will more readily prosper in the university atmosphere, or at least under carefully adapted guidance. Administratively this leads to totally different structures. Variations in approach of project reviewing and differences in general outlook of pure and applied scientists are other reasons. A lot may be said for and against these grounds. In combination with historical reasons they seem fairly conclusive. The strongest motive, however, is this: especially in times of pressure for immediately applicable results, pure science would be in a bad position if a tug of war for funds were possible. A legal guaranty of an independent annual subsidy from the treasury is included in the Z.W.O. Act. This also includes provision for representation of Z.W.O.

[1] Before the devaluation of 1949 a guilder was 38 dollar-cents, now it is a little over 26 (in 1939, 53 cents). It must be borne in mind that the standard of living in the Netherlands is very much different from that in the U.S.A. One guilder goes much farther in Amsterdam than 26 cents in New York. Without claiming that university professors, both here or there, feel that they are adequately remunerated, a comparison may be drawn from the statement that the maximum annual salary of a full professor in a state university is now 12,000 guilders, or nominally 3,160 dollars.

and T.N.O. on each other's boards. And, of course, many other interrelations have been created to ensure perfect cooperation.

Two and a half million guilders ought to be available in 1951. Under the circumstances, while manpower is still the limiting factor in nearly every branch of science, this seems to be adequate for the present. Many plans are, however, being made, for which far larger sums may be needed. Among them an extensive fellowship program is anticipated to find and develop promising talent. The financial situation of the country makes it uncertain if these funds will be found. The present government has an open mind toward science and has done what it could without too many ill-effects on the budgetary balance, which was in view before devaluation but which now again seems a long way off. E.C.A. has already been approached on the question of whether Marshall-aid funds can be directed toward T.N.O. and Z.W.O. It seems certain that only with this help can Z.W.O. reach its more immediate goals.

The financial structure of the organization is such that money appropriated on one year's budget, contrary to governmental practice, can be transferred to the next year or later. This is based on the necessity to assure scientists beforehand that grants for work that will take more than one year will not be withdrawn solely on the grounds of nonavailability of next year's funds. Even though shortage of money has made this an empty gesture thus far, it deserves mention as a legal novelty.

It may be interesting to end this résumé with a few details on expenditures. Of the four million spent up to September 1950, 50 per cent was granted for research in physics and chemistry, mostly in fairly large amounts for well-coordinated work of (often interuniversity) teams. Mathematics got 13 per cent, nearly all of which went to the Amsterdam Mathematical Centre (which is looked on as a possible nucleus of the international mathematical institute that Unesco is planning). Astronomy, geology, and biology were given a total of 11 per cent. Medicine got 13 per cent, divided over a large number of mostly individual research grants. The social sciences had only a few projects, which took, however, 7 per cent of total expenditures; and, finally, 6 per cent went to the humanities in a large number of grants. In this last category falls nearly all the 3.5 per cent made available for publication of books and papers.

Grants vary from 250 guilders for visiting a foreign country to study some geomorphological structures, to a few hundreds or thousands to invite foreign scientists to demonstrate or participate in research from some weeks to several months; to five to ten thousand for publishing studies of history, archaeology, linguistics, ethnology, etc.; to twenty or thirty thousand for analyzing and interpreting results of psychological examinations of draftees for military service; to fifty thousand or more for crystal-structure research with electron rays; to about 150,000 a year for mathematical research and apparatus; to a total of more than a million for highly coordinated work of a large group of physicists. In 1946 two grants were made; this number has steadily risen and reached 119 in 1950. Altogether 275 yearly subsidies were directed toward 179 separate research projects.

Technical Papers

The Colloid Osmotic Pressure of Serum

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The paper "A Rational Method for Calculating Colloid Osmotic Pressure of Serum" (*1*) contains several statements that may be misleading.

One that concerns me particularly is "Scatchard attempted a theoretical derivation, but made an erroneous substitution invalidating his result." Dr. Kesselman informs me that it is our footnote 5 (*2*) that he criticizes. The equations in this footnote are correct except that the indication of a continued series (+ . . .) is omitted in two of the intermediate equations. This footnote makes no attempt at a theoretical derivation. It is merely a restatement of the well-known Donnan equilibrium relations for an ideal solution and their application to real solutions. The last equation in the main paper contains a typographical error, and should read

$$P/c = 268/[1 - (0.4 + 0.9\ \mathrm{pH})c].$$

It should, however, be replaced by the equations of our later papers (*3*, *4*). The equation for the osmotic pressure of plasma in footnote 10, which contains the same error, has been found too limited in application to be recommended.

In the last paragraph Kesselman says, "It is to be noted then that, with all other factors remaining constant, a fall in serum sodium produces a rise in serum colloid osmotic pressure. . . . It is interesting in this connection that oral administration of isotonic sodium chloride has been shown to produce a fall in serum colloid osmotic pressure" (*5*). In this reference, the authors say, "In the present investigation, salt solution was administered in order to effect hemodilution and decrease of the colloid osmotic pressure." It is not impossible that this treatment leads to an increase in the concentration of serum sodium, but

it is certain that the principal cause for the decrease in osmotic pressure is the decrease in the concentration of serum protein.

Perhaps the most dangerous error in Kesselman's paper is the implication that the osmotic pressure at one pH can be calculated from that at another pH by the use of the Donnan equation *for ideal electrolytes*. It has been shown (*2, 4*) that the variation of pressure with pH for albumin is less than one third the value indicated by this equation, so that it is actually more accurate to assume that the variation is zero than to use this equation.

It is true that the osmotic pressure of normal serum under physiological conditions may be calculated by Kesselman's equations, but it may be measured more easily than the quantities from which he calculates it.

The plasma proteins cannot be characterized merely by the albumin-globulin ratio. Oncley, Scatchard and Brown (*6*) report the physical properties of ten of the globulins of normal human plasma, with contributions to the osmotic pressure varying from 5% to more than 75% that of albumin. In pathological sera the quantity of each of these does not change in the same ratio, so the character of the globulin changes as well as its quantity.

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Fumagillin (H-3), a New Antibiotic with Amebicidal Properties[1, 2, 3]

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A new crystalline antibiotic, designated as H-3, with antiphage activity, has been isolated from cultures of a species of *Aspergillus* sp. Hanson and Eble (*1*) first isolated the active concentrates that were capable of inhibiting *Staphylococcus aureus* 209 bacteriophage.

Little antibacterial and antifungal activity was demonstrated, and no antiviral activity was exhibited *in vivo* when tested against MM virus and influenza (PR8A) infections in mice.

We have found this antibiotic to be an extremely potent amebicide, producing inhibitory effects *in vitro* against a strain of *Endamoeba histolytica* (NIH200) with mixed bacterial flora at dilutions as high as 1:131,072,000. The present paper reports preliminary tests designed to investigate the amebicidal potentialities of this antibiotic.

The initial tests showed a crude concentrate (Lot 109-TEE-1) to be effective at dilutions of 1:8,192,000 to 1:16,384,000 in cultures of *E. histolytica* with mixed bacterial flora as shown in Table 1.

TABLE 1

EFFECT OF H-3 ON *E. histolytica* (NIH200) *in Vitro*

Preparation No.	Multiplying bacteria	Minimum effective dilution*
109-TEE-1	Present†	1: 8,192,000
	"	1: 16,384,000
	Absent‡	1: 4,096,000
41-TEE-4 (crystalline)	Present	1: 131,072,000
77-TEE-4 (")	"	1: 65,536,000

* Control tubes with untreated amebae gave heavy growth at 37.5° C for 48 hr.
† Balamuth egg yolk infusion media.
‡ Shaffer-Frye media.

This crude concentrate of the antibiotic when tested in cultures of *E. histolytica* in the absence of multiplying bacteria modified (*2*) after the technique described by Shaffer *et al.* (*3*) was effective at dilutions of 1:4,096,000. Since no associated bacterial growth influenced the growth of the amebae in these cultures, the activity of antibiotic H-3 is interpreted as being direct upon the amebae. H-3 is the first antibiotic or amebicide that has demonstrated such effective amebicidal properties in our laboratories.

Two lots of crystalline H-3 (41-TEE-4 and 77-TEE-4), reported to be five times more active against *S. aureus* phage than the crude concentrate, were approximately as effective against *E. histolytica* and demonstrated activity at dilutions of 1:131,062,000.

The amebicidal properties of H-3 were further tested *in vivo* using young rats experimentally infected with cysts of *E. histolytica* (NIH200) (*4*). The crude concentrate (Lot 109-TEE-1) was found to clear rats of cecal infections of *E. histolytica* when four divided doses were administered orally for 2 days. The total dosage was 36 mg/kg as shown in Table 2. Crystalline preparations (Lots 41-TEE-4 and 77-TEE-4) cleared rats of amebae when four divided doses were administered orally for 2 days. The total dosage was approximately 11 mg/kg. No antibacterial activity has been observed against the intestinal flora in rats.

Further tests were made using the crystalline antibiotic H-3 (Lot 77-TEE-4) against experimental amebiasis in young rabbits infected by the technique described by Tobie (*5*). The antibiotic was found to clear the animals of *E. histolytica* when 4 divided doses were administered orally for 2 days as shown in Table 2. A total dosage of 100 mg/kg was given during this period of treatment.

Additional tests are being conducted in experimental animals to establish an amebicidal end point.

[1] A preliminary report.
[2] Fumagillin, generic name given antibiotic H-3 by the Upjohn Company.

[3] We wish to thank the Upjohn Company which generously supplied us with samples of crude and crystalline H-3.

TABLE 2

EFFECT OF H-3 ON *E. histolytica* (NIH200) INFECTIONS IN YOUNG RATS AND RABBITS

Preparation	Dosage	Mg/kg	Cleared of *E. histolytica* / Animals infected
Young rats, 30–35 g			
109-TEE-1	1.75 Mg×4	210	7/ 7
	0.625 " "	71.25	4/ 4
	0.375 " "	36	7/ 7
	0.1 " "	8.8	0/ 7
Infected controls	—	—	1/28
41-TEE-4 (crystalline)	0.1 Mg×4	11.2	4/ 4
	0.05 " "	8.0	0/ 5
Infected controls	—	—	0/ 8
77-TEE-4 (crystalline)	0.1 Mg×4	11.2	4/ 4
	0.05 " "	5.6	1/ 5
Infected controls	—	—	0/ 7
Young rabbits, 10–12 wks old			
77-TEE-4 (crystalline)	30.5 Mg×4	100	1/ 1
	41.5 " "	100	1/ 1
Infected controls	—	—	0/ 3

H-3 was found to be ineffective *in vivo* when tested against *Trypanosoma equiperdum, T. gambiense,* and *Spirochaeta novyi* infections in mice.

From the present experimental data this new antibiotic H-3 should possibly be one of the best direct-acting amebicides.

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Preparations for Electron Microscopy of Residual Chromosomes[1, 2]

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Both the interest in means for preparing chromosomal material for electron microscopy and the undeveloped status of such direct studies of the fine structure of chromosomes are attested by the recent publication of a number of technical papers. The place of special techniques in this work is indicated by the relative opacity in the electron beam of whole cells (*1, 2*), of nuclei (*3, 4*), and even of isolated whole chromosomes (*5, 6*). Microdissection (*7, 8*), thin sectioning (*9*), squashing with use of replicas (*10*), and smearing (*11*) have been used. Another approach has been through isolation procedures involving physical reductions of cells and fractional centrifugations following Claude and Potter (*12*), Pollister and Mirsky (*13*), and Mirsky and Ris (*14*). Few studies of such isolated material have been made with the electron microscope, some without (*15*) and some with (*6, 16*) use of molar NaCl as developed by Mirsky and Ris (*17*) for the preparation of "residual chromosomes."

This note offers a brief description and some preliminary results of such a technique employing reiterated extractions of the isolated chromosomes with *M* NaCl, ultraviolet absorption spectrophotometry to assay the extractions, and other controls. Preparations of this kind have been the subject of extensive (*17*) and specific (*18*) chemical studies, but in earlier electron microscopy of such material (*16*) only two extractions of the chromosomes with *M* NaCl were made.

In a laboratory at a temperature near 0° C, erythrocytes were separated by centrifugation at 600 *g* from chilled whole blood of White Rock chickens. The supernatant and buffy coat were decanted, and any extraneous sediment was discarded. The cells were repeatedly washed with Gey's solution less the sugar (*19*) (hereafter referred to as "Gey's salt solution") until examination in the light microscope disclosed homogeneous preparations of apparently normal red cells. Suspensions of these cells in Gey's salt solution were reduced in a Waring Blendor by a series of full-speed runs, each of 1 min duration, followed by a cooling period, until microscopic examination revealed strands comparatively free of unbroken nuclei. The total time of treatment in various experiments ranged from 5 to 15 min. A series of centrifugations at 600 *g* then followed, with decantation, gentle resuspension in fresh Gey's salt solution, and pouring to clean tubes at each step, until microscopic examination, including use of Darlington's aceto-orcein, disclosed chromosome threads substantially free of extraneous material. Residual chromosomes were obtained by forcibly injecting a suspension of this material in Gey's salt solution through a #27 hypodermic needle into an excess of *M* NaCl buffered to about pH 7 with *M*/150 Sørensen's phosphate; the mixture was vigorously shaken after addition of each increment of suspension. The homogeneous viscous dispersion resulting was centrifuged for 1–4 hr at about 18,000 *g*, the supernatant being decanted for absorption analysis. Part of the sediment was fixed and mounted for electron microscopy, the bulk being again extracted with fresh *M* NaCl. This extraction procedure was repeated up to 12 times in some experiments. Specimens were mounted on collodion films and shadowed with chromium by standard techniques and examined in an RCA type EMU-2 instrument fitted with a bias gun.

Absorption spectra in the range 2,100–3,200A confirmed the existence of maximum absorption near 2,600A for the supernatants from first and second

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[2] Grateful acknowledgment is made to F. W. Hartman, Director of Laboratories, Henry Ford Hospital, for making available the electron microscope used; to Miss R. M. Sturrock, for electron microscopic services; and to Mrs. G. G. Leithauser, for assistance with some of the preparations.

[3] Now at the Sloan-Kettering Institute for Cancer Research, New York City.

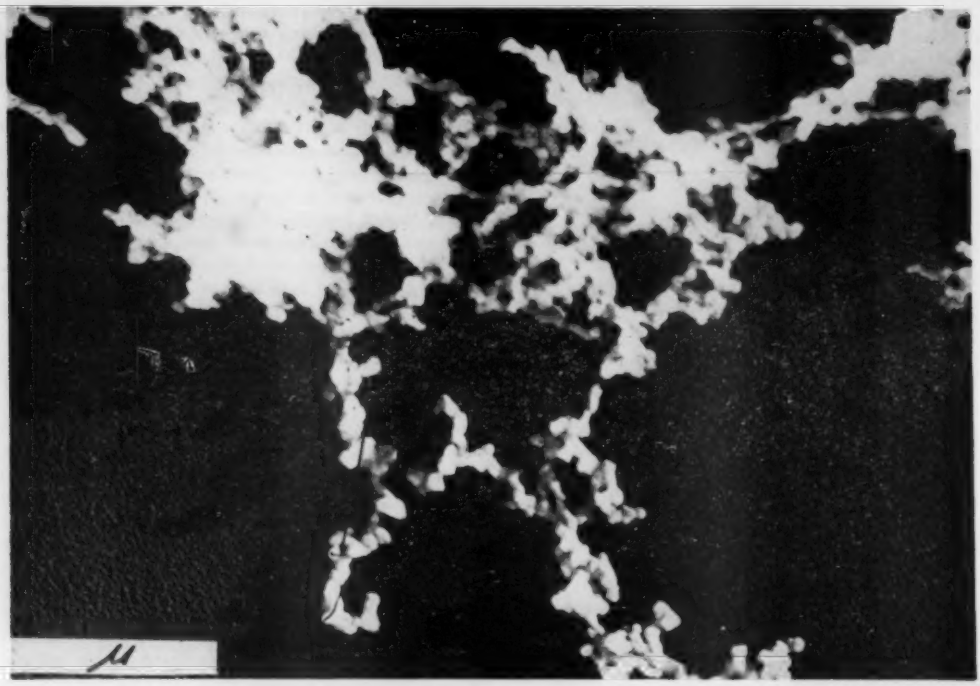

FIG. 1. Residual chicken chromosomes after one extraction with *M* NaCl, bulk-fixed with 2% aqueous chromic acid, shadowed with chromium at 10°.

FIG. 2. Residual chicken chromosomes as in Fig. 1 but after 5 extractions with *M* NaCl.

extractions with *M* NaCl. This absorption was used as a measure of the removal of matrix (desoxyribonucleohistone) from the chromosomes. The data of 7 series of runs showed incomplete extraction of matrix in the first few washes, in which the volume-ratio of *M* NaCl to whole chromosomes was about 50; the transmission approached that of the *M* NaCl only after 5 or more extractions.

As a preliminary indication of the results obtained, Fig. 1 shows the mixture of fine twisted filaments and opaque areas characteristically seen in material after a single extraction; the supernatant was practically opaque at 2,600A. These filaments range from about 200 to 600A in diameter; the appearance of the interspersed opaque areas, usually present, suggested that they represented an amorphous material and were not due simply to poor dispersion of meshes of filaments. A second extraction of this material gave a supernatant with transmission only about half that of the vehicle alone. After 5 extractions of similar material, the supernatant displayed the same transmission as *M* NaCl, and micrographs showed apparently clean strands with none of the opaque areas cited. A seemingly coiled end of such a strand is shown in Fig. 2. Similar contorted clean strands obtained after 12 extractions in another run are shown in Fig. 3; the corresponding supernatant displayed a transmission near that of the vehicle. These bodies show continuous filamentous nature and a wide range of diameters (about 200–1,000A). In Fig. 4 is shown a strand from the material extracted 5 times that disclosed unique structural features; intertwining of 2 strands about 400A in diameter to form one about 900A in diameter is seen, and good prints show indications of transverse banding on the 400A filaments, with a period of about 100A. Although this crossbanding was not regularly observed in these preliminary preparations, it seems likely to be significant as it is not apparently to be confused with the structure of the supporting film.

Mock runs following these preparative techniques in all respects, but with omission of the cells, disclosed no structures to be confused with chromosomal material either in the optical or electron microscopes for stages including mock whole chromosomes, and mock

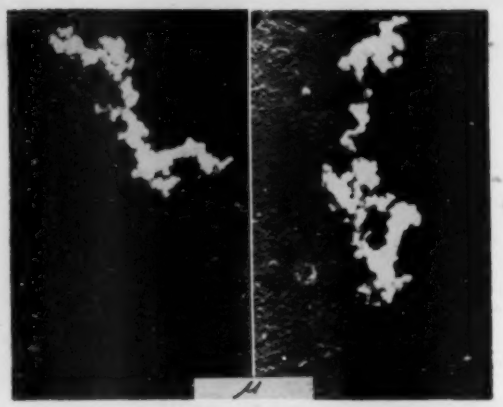

FIG. 3. Residual chicken chromosomes as in Fig. 1 but after 12 extractions with *M* NaCl.

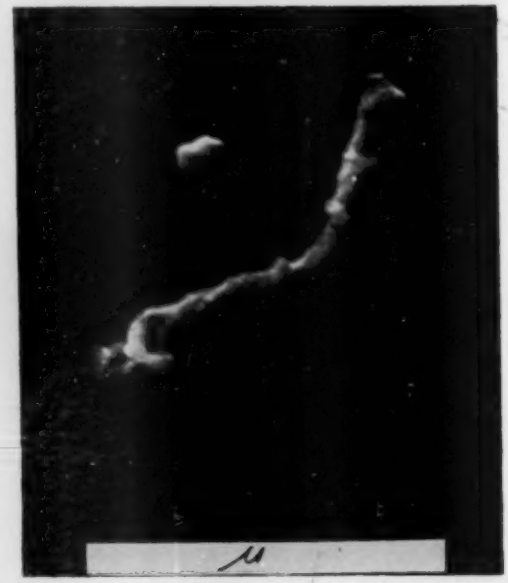

FIG. 4. Residual chicken chromosome as in Fig. 1 but after 5 extractions with *M* NaCl.

first and second residual chromosomes. Later, similar runs offering a partial control employed anuclear sheep red cells and likewise disclosed in the phase microscope no objects similar to chromosomes. Contaminations introducing some absorption at 2,600A were encountered in some mock runs, but these were not of a magnitude to confuse the qualitative picture given here. Despite precautions, an unidentified rodlike body, typically 500A in diameter and from ¼ to 1 μ in length, occasionally double, was seen both in controls and in some of the preparations. The known remarkable appearance of carbon (*4*), and the appearance of casual laboratory dirt in apparently continuous "coiled" filaments, with uniform diameters of the order of 200A were verified in other controls. Such material when introduced here was of lower density than the chromosomal material when viewed on the fluorescent screen of the microscope—a fact that was a qualitative aid to the chromosomal identity of the material under study.

These preliminary results suggest the interest of this technique for the study of the fine structure of chromosomes. The uncertainty of the size range of chicken chromosomes, many of which lie at the limit of resolution of the optical microscope, precludes at present the logical synthesis of such fragmentary information into a picture of the whole chromosome. There is also some further current uncertainty of the identity of such isolates, although we see here obviously nuclear material that seems to satisfy many accessible criteria (form, staining) of chromosomal identity. Thus, in a recent preliminary report, Lamb (*20*) has concluded from optical, phase, and electron microscopic studies of calf thymus cells disrupted for various intervals by sand grinding, by Waring Blendor, or by treatment in the annulus between 2 rotating glass cylinders that the isolated whole "chromosomes" so obtained are but fragments of drawn-out nuclei, found to be single rather than double in the electron microscope. Further, Calvet *et al.* (*15*) have described in a short note meshes of fine fibers obtained by vacuum rupture of such cells, rather than discrete whole chromosomes, and have interpreted these as the classical chromatin net. These workers also interpreted particles obtained through use of the Waring Blendor as random fragments of this network rather than as preformed structural units. Such uncertainties are sufficiently important in the eyes of some workers (*21*) to render uncertain the localization of a protein fraction recently obtained from whole "chromosomes." These views are difficult to reconcile with the careful original work of Mirsky and Ris (*14*), and with the filamentous structures here obtained by extraction of such isolated whole chromosomes, an example of which shows clearly double structure after removal of obscuring matrix (Fig. 4). Most recently, Brues and Rietz (*22*) have presented evidence from the examination of nuclei partially disintegrated by a colloid mill that the chromosomelike structures they isolated are indeed preformed structures in the nucleus. Perhaps one might take heart from the aphorism (*23*) "The nucleus is the chromosomes"! But it is manifest that much further work is needed.

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Ethanol from Methanol[1]

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A method for converting an alcohol to the primary alcohol containing one carbon atom more than the original (homologation) under conditions resembling those employed in the oxo reaction has recently been reported (*1*). The conversion is achieved by treating the alcohol with synthesis gas (carbon monoxide and hydrogen) at 180°–185° in the presence of a cobalt catalyst. The order of reactivity of various starting alcohols was found to be tertiary > secondary > primary. It has now been found that the simplest primary alcohol, methyl alcohol, is anomalous in that it reacts with synthesis gas more rapidly than secondary alcohols. Ethyl alcohol is the chief product of the reaction, and the conversion presents an interesting new route to this alcohol that may have important theoretical and commercial implications. The interest in the reaction from a mechanism point of view arises from the fact that it is impossible for methanol to react via an olefin intermediate.

In one experiment, 2 moles (64.1 g) of methyl alcohol and 4 g of dicobalt octacarbonyl, $[Co(CO)_4]_2$, were placed in a stainless steel autoclave, which had a maximum free space, when empty, of 468 ml. Synthesis gas ($1H_2:1CO$) was added until the pressure reached 3,500 psi, and the autoclave was then heated with rocking to 185° within 65 min. The maximum pressure obtained was 5,100 psi at 181°. The temperature of the autoclave was held at 183°–185° for 4 hr, during which time the pressure dropped to 2,410 psi. The reaction vessel was cooled to room temperature and then repressured to 3,000 psi with 1:1 synthesis gas. The temperature was raised to 185° once more (maximum pressure, 4,560 psi at 167°) and held at this temperature for 4 hr, during which time the pressure dropped to 3,150 psi. The total pressure drop corresponded to approximately 3.6 moles of gas, or 2.3 moles of gas per mole of methyl alcohol converted. After cooling to room temperature overnight, gas samples were taken (over water), and the residual gases vented to the atmosphere. Mass spectrometric analysis of the carefully fractionated mixture showed that 49.0 g (76.4%) of the methyl alcohol had reacted to give the products shown in Table 1. Yields are based on converted methanol.

TABLE 1

Products from the Reaction of Methanol with Synthesis Gas

Compound	Yield (%)
Methyl formate	2.0
Methyl acetate	9.0
Ethyl alcohol	38.8
Ethyl acetate	6.3
Propyl alcohol	4.7
Butyl alcohol	0.9
Methane	8.5
Propyl acetate	0.1
Total	70.3
Water	90.8

Approximately 2.0 g of the distilled product could not be identified. A semisolid residue (6.4 g) containing metallic cobalt and organic material was left in the distillation flask. Acetaldehyde was identified in the lower-boiling fractions as its 2,4-dinitrophenylhydrazone, mp 148.3° – 149.2°, but no estimate of its total concentration could be made.

The absence of appreciable quantities of higher alcohols in the products from the reaction of methanol indicated that ethanol probably would react sluggishly in the homologation reaction. This was confirmed by experiment; a 4.1% yield of *n*-propanol and small quantities of butyl alcohols were secured after a long period of reaction. The variety and distribution of products obtained from methyl alcohol in the homologation reaction have certain similarities to the oxygenated products secured in the Fischer-Tropsch process (*2*). Ethanol is the chief oxygenated product from the Fischer-Tropsch reaction, and relatively small quantities of methyl, propyl, and butyl alcohols are found. The preponderance of ethanol and the relatively small amounts of methanol, *n*-propanol, and butanols in the Fischer-Tropsch process products may be significant in comparison with the rapid conversion of methanol and the slow reaction of ethanol characteristic of the homologation reaction.

The yield of ethanol from methanol can probably be increased by increasing the hydrogen to carbon monoxide ratio of the synthesis gas. It is not necessary to use preformed dicobalt octacarbonyl in this reaction; any salt of cobalt yielding the carbonyl under the conditions of the reaction will serve as an effective catalyst (*1*). A small continuous unit has been con-

[1] Contribution of the Research and Development Branch, Office of Synthetic Liquid Fuels, Bureau of Mines, Bruceton, Pa.

[2] The authors wish to express their appreciation to A. G. Sharkey for the mass spectrometric analyses and to J. Feldman for the distillation analysis.

structed in this laboratory for further studies of this unusual reaction.

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Studies on the Host Range of the Verticillium that Causes Wilt of *Mentha piperita* L.

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Peppermint, *Mentha piperita* L., is one of the important crops in southern Michigan and northern Indiana, where it is cultivated exclusively for its essential oils. The muck soils of these states are particularly well adapted to the cultivation of this crop, and in those areas such soils are devoted almost entirely to peppermint oil production. However, during the past decade there has been a rapid decline in peppermint acreage, particularly in Michigan, as a result of infestation of the soil with a fungus which causes the serious mint disease known as Verticillium wilt.

This disease was first reported in Michigan by Nelson (*1*) in 1926, and since that time it has become common throughout the peppermint-raising areas in that state. In 1941 it was noted by Baines (*2*) for the first time in Indiana, where it has likewise become very prevalent and important. Baines identified the causal agent as *Verticillium albo-atrum* R & B, but Nelson (*3*), in 1947, subsequently claimed that it more nearly resembles *V. dahliae*, a species which Rudolph (*4*) had previously believed to be invalid.

So far no completely successful control measures have been developed. Breeding of resistant varieties has been attempted, but this work is greatly hampered by the fact that the flowers of *M. piperita* are male sterile. At the present time crop rotation appears to be the most promising means of control. The success of such measures, however, will depend on the susceptibility of other crop and weed plants to the disease, the ability of the causal agent to persist for long periods of time as a saprophyte in the soil or in plant debris, the agricultural practices adopted, and on many other factors.

In view of the economic importance of Verticillium wilt and its rapid spread in Michigan and Indiana, extensive research programs have been initiated on the identity, variability, and pathogenicity of the causal organism, control measures, susceptibility, and host range. Nelson (*3*) reported that the isolate of *V. albo-atrum* from *M. piperita* is specific to this host and closely related species of *Mentha*. He also stated that *M. piperita* is resistant to isolates of *V. albo-atrum* from a number of unrelated host plants.

The present study was undertaken to ascertain the susceptibility of the major weed and crop plants of the muck soil regions of northern Indiana, to determine the ability of *V. albo-atrum* to exist as a saprophyte in the soil and on vegetable debris, and to check the above reports on the host specificity of the causal agent and the resistance of *M. piperita* to isolates from unrelated hosts.

In the susceptibility tests the following weed plants and their seeds were collected from within and around the fields in which *M. piperita* is cultivated and were used as host plants under greenhouse conditions:

Lactuca scariola L.
Mentha rotundifolia L.
Echinochloa crusi-galli Beauv.
Erysimum cheiranthoides L.
Chenopodium album L.
Cannabis sativa L.
Lepidium virginicum L.
Bidens vulgata L.
Taraxacum vulgare Lam.
Persicaria hydropiper L.
Amaranthus retroflexis L.
Portulaca oleracea L.
Oenothera biennis L.
Aster ericoides L.
Ambrosia trifida L.
Rumex altissimus L.
Plantago major L.
Rudbeckia hirta L.
Urtica dioica L.
Erigeron canadensis L.
Physalis subglabrata M & B

As soon as these plants had attained appropriate size they were inoculated with pure cultures of causal agent via the soil, and after 10 days a second inoculation was made in the same manner. Adequate controls were set up for each species. The fungus isolate used in these experiments was taken from *M. piperita* and will be referred to as *V. albo-atrum* B11B to distinguish it from isolates from other host plants. In the course of a period of 45 days after inoculation, attempts were made to recover the causal organism from the roots and stem of each inoculated plant, using techniques that have proved successful in isolating *V. albo-atrum* B11B from *M. piperita*.

The results of these susceptibility and specificity tests were striking. *V. albo-atrum* was isolated from only one of the tested species, *M. rotundifolia*. This species is closely related to *M. piperita*, which may possibly be the reason for its susceptibility. In addition to the above greenhouse and laboratory tests, field surveys were conducted during the late spring, summer, and fall seasons. Weed plants were carefully observed within and along the boundaries of fields of *M. piperita*. No definite symptoms of the disease were found. Nevertheless, specimens were collected on each survey, and attempts were made to isolate *V. albo-atrum* B11B from their roots and stems. None of these plants yielded the causal agent.

Economic plants were selected as representative of the various types of crop plants cultivated in the muck soil regions of northern Indiana. Some of the species of crop plants utilized are of somewhat minor

importance but, as the trend toward diversification continues, may become more significant. The species of plants used in these experiments were:

Solanum tuberosum var. Chippewa
Lycopersicon esculentum var. John Baer
L. esculentum var. Southland
Solanum melongena var. Black Beauty
Capsicum annuum var. Calwonder
Brassica oleracea var. Golden Acres
Cucumis sativus var. David Bland
Allium cepa var. Yellow Globe
Zea mays saccharata

These plants were inoculated either by dipping the root system of the young seedlings in a heavy suspension of spores, sclerotia, and mycelia of *V. albo-atrum* and transplanting, or by working pure cultures of this fungus into the soil around the base of the plants. Control plants were maintained, and all the plants were allowed to grow for a period of 45 days. At the end of this period, attempts were made to recover the causal agent from all the plants inoculated.

V. albo-atrum B11B was recovered from two species of plants inoculated—namely, from the roots and aerial stems of 6 of 20 plants of *Solanum melongena* var. Black Beauty—and also from 4 of 20 plants of *Capsicum annuum* var. Calwonder, but only from the primary and lateral roots and never from the aerial stem.

These results seem to indicate that the isolate of *V. albo-atrum* from *M. piperita* is not as specific to that genus as has been believed.

The ability of *V. albo-atrum* B11B to exist as a saprophyte was determined by inoculating sterilized plant debris with pure cultures of the fungus. At the end of an incubation period of 30 days the relative amount of mycelial development was used as the criterion of the suitability of each substrate as a growth medium. The results of this experiment are shown in Table 1. It is to be noted that growth was excellent on *M. piperita* and *Chenopodium album*, and good on all other species except *Cannabis sativa*.

TABLE 1

Plant debris	Amt. growth
Solanum tuberosum L.	**
Lycopersicon esculentum Mill.	**
Capsicum annuum L.	**
Brassica oleracea L.	**
Mentha piperita L.	***
Amaranthus retroflexis L.	**
Chenopodium album L.	***
Portulaca oleracea L.	**
Cannabis sativa L.	*
Oenothera biennis L.	**

*** Excellent.
** Good.
* Poor.

The fact that the debris of *M. piperita* proved to be an excellent substrate is highly significant from the standpoint of control. After the oil has been distilled from the leaves and stems, the debris is used by many growers as organic fertilizer, and doubtless serves as a medium for propagating the fungus in the soil.

The final phase of this investigation dealt with the susceptibility of *M. piperita* to isolates of *V. albo-atrum* from other plants. Healthy plants of *M. piperita* were inoculated (via the soil, as in the previous experiments) with pure cultures of *V. albo-atrum* from potato, tomato, eggplant, nightshade, okra, honeydew melon, radish, boysenberry, and *Aralia japonica*. The results of these tests were negative except in two cases. *V. albo-atrum* No. 119 from tomato proved to be cross-infective with *M. piperita*, as did the isolate No. 53 from radish. In the latter case, however, the fungus was recovered only from the stem below the soil level and the smaller lateral roots of *M. piperita*.

From the standpoint of establishing a feasible crop rotation program to control peppermint wilt, our results seem to indicate that the natural flora and other economic plants of the muck soil regions of northern Indiana are relatively insignificant as hosts of *V. albo-atrum* B11B. Furthermore, our results show that this isolate is an efficient saprophyte and, barring inhibition by other microorganisms and environmental factors, it may persist on plant debris and in the soil for long periods of time. In addition, the results obtained indicate that *V. albo-atrum* B11B is not as specific in host range as previously believed. These results also support evidence from other sources for the existence of strains of *V. albo-atrum* which vary in host specificity and pathogenicity. Research now in progress is being done in an attempt to determine the stability of the proposed strains of the fungus *V. albo-atrum*.

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Formation of Thianthrene by a Free Radical Mechanism

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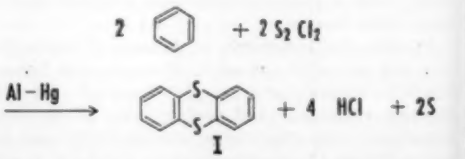
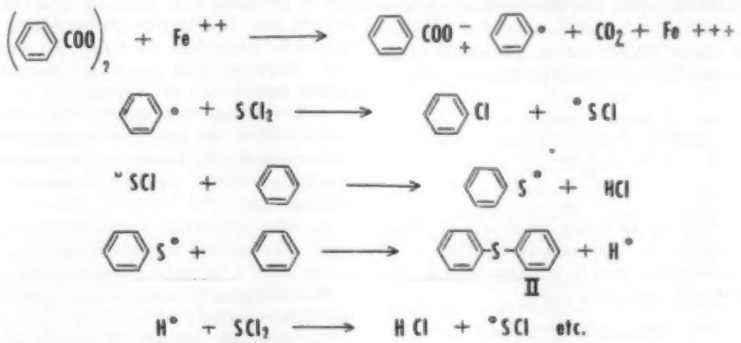
Cohen and Skirrow (*1*) observed the formation of thianthrene (I) from benzene and sulfur monochloride



in the presence of an aluminum amalgam. These authors found that the reaction was very rapid and that the aluminum-mercury couple, used in small amount, was not affected by the reactants. These data seemed

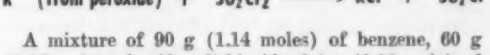
to indicate that the thianthrene was formed in this reaction via a free radical chain mechanism initiated by the aluminum-mercury couple. Schonberg (*2*) has observed the formation of thianthrene as a product from the dissociation of diphenyl disulfide into free radicals as shown in the accompanying equations.

We have found that thianthrene is formed in low yield by the reaction of benzene and sulfur dichloride (SCl_2) in the presence of benzoyl peroxide and a ferrous ion activation system (*3*). The thianthrene was not formed from benzene, sulfur dichloride, and ferrous salt under corresponding conditions of temperature and concentration, indicating that the presence of the peroxide was necessary for thianthrene formation. These data lead us to postulate that the thianthrene was formed as a result of the introduction into the system of free phenyl radicals from the benzoyl peroxide and the subsequent transformations represented below.

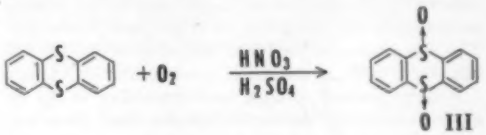


Thianthrene would result from an attack of another ·SCl radical on the diphenyl sulfide (II) at the *ortho* position, followed by ring closure. There is the possibility here also for the formation of higher molecular weight polymer types by the attack of ·SCl at the *para* positions in diphenyl sulfide or at any position in a previously formed thianthrene molecule. We have some indications that considerable quantities of such polymers are formed.

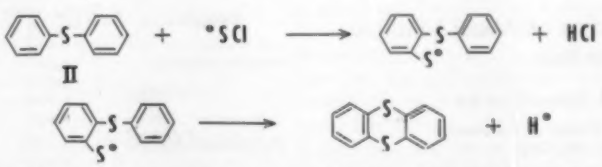
The decomposition of SCl_2 by the phenyl radical, as represented in the second equation in the above series, is analogous to a reaction postulated by Kharasch and Brown (*4*) as an intermediate in the peroxide catalyzed chlorination of hydrocarbons with sulfuryl chloride.



A mixture of 90 g (1.14 moles) of benzene, 60 g (0.57 mole) of sulfur dichloride, 2.4 g (0.02 mole) of ferrous carbonate, and 4.8 g (0.02 mole) of benzoyl peroxide was heated to reflux. There was a vigorous evolution of hydrogen chloride, which gradually subsided. After 6 hr of reflux, the mixture was distilled.



After removal of volatile excess reactants, the residue was heated to 300° C under 30-mm pressure, and all distillate was collected. The small amount of distillate was washed with aqueous sodium hydroxide to remove benzoic acid. Thianthrene was difficult to isolate from the mixture directly, so it was oxidized under conditions found effective for converting thianthrene to

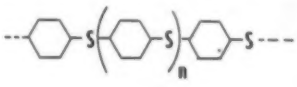


thianthrene-5,10-dioxide (III), and the higher-melting, less soluble oxidation product was obtained and characterized as indicated in equation (III) above.

The residue from the sodium hydroxide wash above was suspended in 100 ml of concentrated sulfuric acid, cooled to the range of −5 to 0° C, and 100 ml of fuming nitric acid (sp gr, 1.5) added over a 1-hr period,

with stirring and cooling to maintain the temperature of the reaction mixture in the −5 to 0° C range. The mixture was allowed to stand for 1 hr at the same temperature, and the resulting clear solution was poured over crushed ice. The precipitated solid was removed by filtration, washed with water, and recrystallized from ethanol to yield 0.7 g (1.1%) of thianthrene-5,10-dioxide melting at 284–86° C. The literature reports the mp of this compound at 283–84° C (*5*). The 284–86° C melting product above was identical in mp and mixed mp with a sample prepared by oxidation in 80% yield of an authentic specimen of thianthrene by the same procedure used above. The thianthrene-5,10-dioxide was further characterized by its reduction with zinc dust and acetic acid to thianthrene according to the procedure of Krafft and Lyons (*5*). The thianthrene so produced was identical in mp and mixed mp with an authentic specimen.

A large amount of dark solid remaining in the reaction vessel after the distillation described above was ground to a fine powder and extracted repeatedly with carbon disulfide in order to remove occluded sulfur. The remaining solid was insoluble in all common solvents and melted above 300° C. This material was organic and possessed the properties of a polymer. A Parr bomb sulfur analysis on this product showed 35.95%. A polymer of the structure shown below would contain about 29.7% sulfur, as would other possible structures. The extra sulfur may be held in



S
↑
—S— type linkages or occluded mechanically. This product was formed in approximately 85% yield based on the assumption that it corresponded to the polymeric structure represented above.

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Acidimetric Titration of Alkali Chloride and Hydrochloride Salts

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Although chlorides, such as sodium and potassium chloride, are generally considered to be model examples of neutral salts, this is only relatively true. We have recently been able to titrate these, as well as hydrochlorides of amines, as bases with perchloric acid, using acetic acid as the solvent. In glacial acetic acid, which is considerably less protophilic than water, hydrochloric acid is largely unionized, being one of the relatively weaker inorganic acids, and is readily volatile. The titration of these salts in acetic acid would then be analogous in a sense to titration, for example, of alkali carbonates in water.

TABLE 1

Titration of Procaine and Procaine Hydrochloride in Glacial Acetic Acid

Sample	Equiv/mole found
Procaine	1.96
	1.96
	1.97
Procaine hydrochloride	1.92
	1.94
	1.94
	1.93
	1.95

Although acidimetric titration of bases in acetic acid with perchloric acid is a relatively well-established method (*1*), there appears to be no reference in the literature to the possibility of titrating chloride salts in this medium. We ourselves were led to this observation during a more or less routine application of the glacial acetic acid-perchloric acid method to the analysis of procaine and procaine hydrochloride. As expected, two equivalents of perchloric acid were required to neutralize the base. We were surprised to find, however, that the hydrochloride salt also required nearly two equivalents per mole. This seemed to indicate that hydrochloric acid was too weak an acid to affect the indicator, α-naphthobenzein, in the solvent employed. This conclusion pointed to the possibility of direct acidimetric determination of any chloride salt.

In order to test this possibility, the method has been applied to sodium, potassium, and ammonium chloride in addition to procaine hydrochloride.

The following procedure was employed in obtaining the data reported:

The weighed sample (0.1–0.5 g) was placed in a

TABLE 2

Acidimetric Titration of Sodium, Potassium, and Ammonium Chloride

Sample	Equiv/mole found	Indicator
Sodium chloride	0.997	α-Naphtholbenzein
	1.001	
	0.994	
	0.996	
Potassium chloride	1.016	Methyl violet
	1.018	
	1.024	
	1.020	
	1.020	
Ammonium chloride	1.000	α-Naphtholbenzein
	1.002	
	0.995	
	0.994	
	1.005	

250-ml Erlenmeyer flask with 50 ml of glacial acetic acid. The mixture was brought to a boil, and a few drops of an indicator (0.1% in benzene) was added. The solution was then titrated with a standardized perchloric acid-acetic acid solution (0.04–0.2 *M*), the solution being reheated near the end point to sharpen the indicator change. Where relatively insoluble salts —e.g., sodium chloride—were used, it was necessary to bring them gradually into solution by repeated heating and titrating.

In Table 1 are listed results obtained by titrating both procaine and procaine hydrochloride. The presence of the acidic group in the latter compound appeared to have no significant influence on the diacidic character of the original base.

In Table 2 the data obtained by titration of sodium, potassium, and ammonium chloride are presented. The titration of sodium chloride proved to be difficult because of its poor solubility in the solvent. In all cases, however, the salts behaved as monoacidic bases.

The observation that the titration end point faded on heating and that the stoichiometric end point was achieved best by bringing the solutions under titration to a boil appeared to indicate that the part of the apparent basicity of the chloride ion was due to the volatility of the acid formed; that is,

$$Cl^- + CH_3CO_2H_2^+ \rightleftharpoons \overset{\uparrow}{\underset{\text{HCl (gas)}}{HCl}} + CH_3CO_2H.$$

The equilibrium in the above reaction appears to favor the right-hand side, permitting partial titration of the ion without loss of hydrogen chloride from the system. Near the end point, however, the reverse reaction becomes appreciable unless the gas is driven off by boiling.

This hypothesis was partly verified by applying the titration procedure to potassium bromide. In this case the indicator change occurred with only a slight addition of perchloric acid solution; however, it was possible to approach the stoichiometric end point by repeated boiling of the solution, the indicator reverting to the nonacid color after each heating up to the end point. Results obtained in this fashion are presented in Table 3.

TABLE 3

ACIDIMETRIC TITRATION OF POTASSIUM BROMIDE IN GLACIAL ACETIC ACID

Sample	Equiv/mole found	Indicator
Potassium bromide	0.969	α-Naphtholbenzein
	.973	
	.973	
	.984	
	0.976	

Since HBr is a much stronger acid than HCl, the former would be expected to be more highly ionized in acetic acid than the latter. This would explain the initial indicator change observed on addition of a small amount of the perchloric acid solution to potassium bromide. Because of the volatility of HBr, however, the indicator can be driven back to the basic form, permitting the titration to be carried through to the stoichiometric end point.

These observations have been further verified by results obtained by N. F. Hall and co-workers (*2*), using potentiometric means to follow the relative acidity of the acetic acid solutions.

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A Comparison of the Niacin and Pantothenic Acid Content of Certain Cereal Grains Grown under the Same Environmental Conditions

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For many years the emphasis in food production has been on higher yields, and the introduction of hybrid varieties of cereals has resulted in increased production per acre. Within recent years feeding experiments have shown that there is considerable variation in some of the quality factors—such as vitamins—among the different hybrids of any one cereal. Breeding programs have been undertaken to develop high-quality cereals. The work of Richey and Dawson (*1*), Burkholder (*2*), and Ditzler *et al.* (*3*) tends to show that the genetic factor may be the major influence in determining the niacin content of corn, and Hunt *et al.* (*4*) showed that the niacin content of corn is less subject to modification by environmental conditions than is pantothenic acid.

This report presents the data obtained with respect to the niacin and pantothenic acid content of several varieties of each of four different cereals grown under the same environmental conditions.

The cereals analyzed were two double-cross hybrids of corn (*Zea mays* L.), M20 and K24; four varieties of wheat (*Triticum aestivum* L.), Seneca, Trumbull, Butler and Thorne; two varieties of oats (*Avena sativa* L.), Clinton and Wayne; two varieties of soybeans (*Glycine soja* L.), Hawkeye and Lincoln. All are new, but well-established varieties and are used extensively in Ohio. They were all grown the same season on Wooster silt loam at the Ohio Agricultural Experiment Station on plots that were in a high state of fertility. Each sample of grain was ground in a Wiley mill through a 60-mesh sieve.

The niacin and pantothenic acid content was determined by the microbiological method as outlined in *Methods of Vitamin Assay* (*5*), based on the original method of Snell and Wright (*6*). The organism employed was *Lactobacillus arabinosus* 17-5. The results of the analysis are summarized in Table 1.

TABLE 1

COMPARISON OF NIACIN AND PANTOTHENIC ACID CONTENT IN CEREALS

Cereal		Niacin (γ/g)	Pantothenic acid (γ/g)
Species	Variety		
Corn	M20	19.5	6.4
	K24	25.8	6.5
Wheat	Seneca	46.0	8.53
	Trumbull	50.4	10.6
	Butler	48.8	10.1
	Thorne	46.8	10.8
Oats	Clinton	12.3	15.27
	Wayne	15.8	16.7
Soybeans	Hawkeye	26.6	20.4
	Lincoln	22.8	29.4

The results show that there is a wide variation among the four cereals studied with respect to the niacin and pantothenic acid content, the differences being greater with niacin than with pantothenic acid. Among the varieties within the species the niacin content showed a wide variation in the case of corn, oats, and soybeans, but very little in the case of wheat. Soybean was the only cereal that showed any marked variation of pantothenic acid.

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On the Cleavage and Oxidation of Pteroylglutamic Acid by Enzyme Solution

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In spite of many reports which showed that pteroylglutamic acid (PGA) had been liberated from its conjugated forms by conjugase from different sources, there is almost no information about the enzymic cleavage of PGA itself. In our experiments we proved that PGA is split by liver enzyme solution.

Preparation of the enzyme solution: 100 g fresh cattle or rabbit liver was ground with 100 ml water, allowed to stand at room temperature for 2 hr, and then centrifuged. The supernatant was dialyzed through collodion membrane in running water. All experiments were carried out at 37° C, and the pH of the solution was kept at 7.5 with phosphate buffer. For the test the methylene blue technique was used.

[1] We are greatly indebted to S. Kuwada, director of the Takeda Research Laboratory, for a gift of PGA.

Expt. 1. The following system was taken: 0.1 ml of the cattle liver enzyme solution, 0.1 ml of *M*/15 phosphate buffer, 0.2 ml of *M*/5,000 solution of methylene blue, and 0.1 ml of *M*/200 solution of substrates.

Tube No.	Substrates	Time of reduction
1	PGA	49 min
2	*p*-Aminobenzoylglutamic acid	38 "
3	L-glutamic acid	26 "
4	Control	6 hr

Expt. 2. The following system was taken: 0.1 ml of the rabbit liver enzyme solution and other components as in expt. 1.

Tube No.	Substrates	Time of reduction
1	PGA	19 min
2	*p*-Aminobenzoylglutamic acid	17 "
3	L-glutamic acid	17 min, 50 sec
4	Control	7 hr

Expts. 1 and 2 show that PGA can reduce the methylene blue by the liver enzyme solution in the same manner as *p*-aminobenzoylglutamic acid and L-glutamic acid, and the oxidation of the former is little slower than the latter two. The similar result has been confirmed through several repeated experiments. It thus seems more reasonable to think that PGA is hydrolyzed to the pteroic acid and the glutamic acid, the latter of which reduces the methylene blue with the glutamic acid dehydrogenase, than to think that PGA itself is oxidized. The assumption seems likely from the fact that the *p*-aminobenzoylglutamic acid has reduced the methylene blue at almost the same rate as that of PGA under similar conditions. But in our experiment there was no detectable *p*-aminobenzoylglutamic acid or *p*-aminobenzoic acid liberated because even the most sensitive diazo color test upon *p*-aminobenzoic acid gave negative results in the reaction mixture.

It must be added that when the dialysis of the enzyme solution is not sufficient and some donators remain as purines, it often happens that the system added with PGA as substrate is more slowly reduced than the control. As PGA has strong inhibitory action upon the xanthine oxidase in milk (*1*), it seems likely in this case, too, that PGA has inhibited the oxidation of the purines remaining on account of the unsatisfactory dialysis of the liver extract.

Xanthine oxidase and xanthopterin oxidase exist in milk and liver, but it would seem that no enzyme exists to oxidize directly the pteridine nucleus of the intact PGA or pteroic acid. This assumption was confirmed by reduction of methylene blue with the pteroic acid by means of the liver enzyme. The proof of glutamic acid (formol titration and ninhydrin test) which may be liberated by the cleavage of PGA with the liver enzyme, is now under investigation.

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Comments and Communications

Editorial Policy

EDITORS of scientific journals have two reasonable ways of dealing with bad work. The best way is to reject it. The second way is to publish it and be ready also, to publish a reader's criticism of it. Too often, at present, neither policy is followed; instead, the bad work is published without criticism, because critical letters are against the policy of the journal.

Some scientists tolerate this situation for the sake of peace; they are not compelled, they say, to take notice of bad work. At the same time, their own work will be delayed in publication, and will lie in strange company in the journal's pages when it finally appears. I do not agree that we should let bad work go uncriticized; fear of criticism is a valuable check on bad work. But if an editor will not allow correspondence, it is all the more his duty to keep his standards high.

However, there are legends in our midst to the effect that some great man was neglected during his lifetime because his theories were so strange that the journals would not publish them. Perhaps a very small proportion of these legends may be true, at least in a modified form. But the belief in them is real, and that seems to be why some editors are too timid to reject bad work—they are afraid that thirty years later it may turn out to have been good after all. It is clear that if one abandons one's judgment to that extent there is nowhere to stop. In short, I can see no sensible alternative to the two policies which I first suggested.

I would like to illustrate my case with an example. No doubt many readers may be able to supply their own, but the following may also provide chemists and botanists with a chuckle.

The main theme of this article (Cooper, H. P., *Soil Science*, 69, 7 [1950]) could be expressed as follows: "The more difficult it is for the ion of a metal to be reduced to the metallic state, the more freely that ion will be absorbed by plants." (This rule actually holds for the sequence K, Ca, Mg, Fe, but breaks down, for example, with Na.) A second theme could be expressed, "A major action of light falling on a plant is to decompose molecules into their elements; for example, light of wavelength 4300–4400 angstroms has just the right amount of energy to decompose magnesium chloride into free magnesium and chlorine."

I have reworded both these themes to make them readable. The second theme appears thus in the article: "The radiant energy absorbed by chlorophyll is approximately the same as the decomposition voltage of certain nutrient salts [the accompanying table lists $FeCl_2$, $CrCl_2$, $ZnCl_2$, $MnCl_2$, $AlCl_3$, and $MgCl_2$]; therefore, it seems logical to assume that absorption of radiant energy by plants may result in reducing certain nutrient compounds to the elemental state."

Both theories imply that the elements exist as such—potassium, iron, magnesium, chlorine—inside the plant, at least temporarily. In reply to a statement that this precipitation of potassium is absurd, the author merely says (p. 29) that "many nutrients are solids in the elemental state and cannot be evolved like those that are gases" (referring here to oxygen in particular). This does not help us much; if the metallic potassium does not evolve like a gas, it ought to be demonstrated all the more easily as it lies glistening within the cell.

The paper includes a table (p. 10) showing that iodide and sulfide are equally strong reducing agents, and that acetate is a stronger oxidizing agent than chlorate.

The editor of the journal introduced this article with an explanatory note saying that, of many referees, all but two were against publication.

It seems only too clear that the reason for publishing this kind of article is the fear that later ages may consider it sensible. We come back then to the choice suggested at the start. Bad work should not be published, but if it is, then the same journal should open correspondence columns in which critics can give it the treatment it deserves.

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Agenda for S.U.N. Commission (I.U.P.A.P.), July 1951

AT THE next meeting (Copenhagen, July 1951) of the International Union of Pure and Applied Physics, the Commission on Symbols, Units and Nomenclature will discuss and may adopt resolutions recommending the universal use of certain units and symbols of interest to many American physicists, including certain symbols and nomenclature for nuclei, and units for electricity and magnetism. Universal agreement on units and symbols is certainly desirable although admittedly very difficult of attainment. It is a policy of the S.U.N. Commission to recommend a usage only when there is overwhelming support for it. The commission therefore invites discussion of questions on its agenda and in particular the questions presented here. Comments and discussion may be sent directly to Professor J. de Boer, Secretary of the S.U.N. Commission,[1] University of Amsterdam, Holland, or to the writer of this notice for transmittal to the commission.

NUCLEI

1. *Symbols for nuclei.* It has been proposed that the

[1] A. Perard, Director of the International Bureau of Weights and Measures, Sèvres, France, is president of the S.U.N. Commission. Other members are: J. de Boer (Amsterdam), E. Griffiths (Teddington), H. Konig (Berne), E. Perucca (Turin), and F. G. Brickwedde (Washington).

"diagonal" notation for nuclei be universally adopted. An example of this notation is:

$$_{3}Li^{6} \text{ which is } {}_{(\text{atomic no.})}Li^{(\text{mass number})}$$

This is already in general use by American physicists. It is objected to by French scientists, especially chemists, who indicate the atomic composition of molecules by upper right-hand indices (e.g., H^2O). This upper index notation for the composition of molecules, however, is in contradiction to a previously made recommendation of the S.U.N. Commission. Also, some American chemists prefer to reserve the upper right-hand index space for the sign (+ or −) of an ion.

The indication of the atomic composition of molecules by lower right-hand indices would be retained. Two suggestions for writing the atom numbers are illustrated by

(*a*) Li_2^6 and (*b*) $(Li^6)_2$.

The second form (*b*) has the advantages that it does not require the back-spacing necessary for the typing of parallel super- and subscripts, and it can be printed with regular superscript and subscript monotype. The parallel notation of form (*a*) calls for special type.

2. *Nomenclature for nuclei.* It is proposed that the word *monobar* be universally used to indicate a single atomic species having a definite atomic number and a definite mass number, as $_1H^3$ and $_9F^{19}$. It is proposed also that the word *isotopes* be used only to indicate monobars having the same atomic numbers but different mass numbers. *Isobars* would be recommended to indicate monobars having the same mass numbers but different atomic numbers.

Electrical Units

1. *The Giorgi–MKS system and the fourth (electrical) unit.* The general Assembly of the International Union of Pure and Applied Physics in Amsterdam, July 1948, approved the following resolution proposed by the S.U.N. Commission:

> The International Union of Pure and Applied Physics decides to ask the International Bureau of Weights and Measures to accept for international use, an *international practical system* of units. It is not proposed that the CGS-system should be abandoned by physicists.
>
> The International Union of Pure and Applied Physics recommends as an international practical system of units the system: *metre, kilogram (mass), second* and an electrical unit of the absolute practical system (to be chosen in near future).
>
> The unit of force in this system (i.e., the force, which acting on a mass of 1 kg produces an acceleration of 1 m/s^2) should be called the *newton.*

The Union of Physics had two objectives in making this recommendation: (1) the elimination of other practical systems of units which use mass units as force units, and (2) to get a reaching of agreement on the fourth quantity of electrical or magnetic nature for a satisfactory description of electric and magnetic phenomena.

The above resolution of the union made no choice for the fourth unit. There is merit in the suggestion that electric charge or electric current be used as the basis of the fourth unit. Industrial physicists have advocated fixing the numerical value of the permeability of vacuum at 10^{-7}, making the practical MKS units decimal fractions or multiples of the electromagnetic CGS units.

2. *The rationalization of the electrical units.* A report of the S.U.N. Commission approved by the General Assembly of the Union of Physics, London, 1934, states that because "it appears improbable, that an overwhelming preponderance of opinion either favourable or unfavourable to rationalization [avoidance of the factor 4π in Maxwell's equations] will be manifested in the near future," further action should be deferred until agreement on this matter has been reached. Although the situation has not changed much, it is probable that rationalization of the electrical units will again be discussed at the Copenhagen meeting.

It may be helpful to reach agreement first on a few general principles governing the choice. Two principles suggested are:

a) Physical equations in textbooks and scientific journals should be mathematical relations between physical quantities and hence be independent of the system of units used for the numerical evaluation of the quantities.

b) Unit-systems should always be coherent or germane, i.e., should not require the introduction of numerical conversion factors different from unity in the unit equations defining the derived units in terms of the fundamental units of its own system. The electrostatic and electromagnetic CGS units and the Giorgi-MKS units are each coherent unit systems. The volt as a unit of kinetic energy of an electron is an incoherent unit since the equation defining it in terms of the regular units of energy involves the charge of the electron as a numerical factor.

On the basis of these principles, rationalization should be considered as a change in the definition of some physical quantities, as:

$$D' = D/4\pi \qquad \varepsilon' = \varepsilon/4\pi \qquad \rho' = \rho/4\pi$$
$$H' = H/4\pi \qquad \mu' = 4\pi\mu \qquad M'(= B - \mu_0 H') = 4\pi M$$

This makes the factor 4π disappear from Maxwell's equations and reappear in the force laws between electrical charges and currents and in problems involving spherical symmetry.

As it is to be expected that the quantities defined according to the rationalized equations will be used at the same time as the classical definitions, it is very important that the rationally defined quantities should be given a *new name* (an adjective of prefix to the classical name) and a *modified symbol* (suggestions: upper index r, prime as in the paragraph above, or another symbol, such as might be had by combining a solidus with D, H, ε, etc., in analogy to the Dirac $\hbar$).

It is of interest to note that at the meeting of Technical Committee Number 24 (Electric and Magnetic Magnitudes and Units) of the International Electrotechnical Commission, held in Paris July 1950, the following conclusions were reached:

1. It was recorded that "newton" was finally adopted as the name for the unit of force in the Giorgi system.
2. The ampere was adopted as the fourth principal unit of the Giorgi system.
3. The so-called total rationalization of the Giorgi system was adopted.
4. An Experts Committee was set up to study the rationalization process and prepare questions to be considered at the next meeting.

Although such recommendations of the I.E.C. can have no legal force, they will doubtless be used by many engineers and writers of textbooks as a guide to preferred practice. It is very fortunate that Professor de Boer could participate in the meetings last July and is (as observer) a member of the Experts Committee.

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Cobalt 60 Labeled Vitamin B_{12} of High Specific Activity

A recent report (Chaiet, Rosenblum, and Woodbury, *Science*, **111**, 601 [1950]) described the microbial synthesis and isolation of crystalline vitamin B_{12} labeled with cobalt 60. The specific activity of this preparation was $\simeq 0.25$ μc/mg. The specific activity of the vitamin is determined by the specific activity of the cobalt added to the nutrient medium, by the extent of utilization of cobalt naturally present in the medium, and by the cobalt content of vitamin B_{12}. The highest specific activity cobalt 60 obtainable from the U. S. Atomic Energy Commission is an amount of 2,000 μc/mg ("Isotopes," *Catalog and Price List No. 3*, [July 1949]). The cobalt content of vitamin B_{12} has been reported variously as 4.5% (Brink, N. G., *et al.*, *J. Amer. Chem. Soc.*, **71**, 1854 [1949]) and 4.0% (Fantes, K. H., *et al.*, *Proc. Royal. Soc. London*, **136–B**, 592 [1949]). Assuming the 4.5% figure, and ignoring the possibility of an inactive cobalt (59) contribution from the broth, the maximum specific activity currently attainable is 90 μc/mg vitamin.

In more recent experiments we have been able to approach this maximum. Starting with cobalt 60 (purchased as the nitrate from Tracerlab, Inc., on allocation from the AEC) of specific activity 1.800 μc/mg added to the nutrient medium, we obtained a product with a specific activity of $\simeq 67$ μc/mg. The highest specific activity expected was 72–81 μc/mg, depending on the value (4% or 4.5%) taken for the cobalt content of vitamin B_{12}. Despite the uncertainty in the cobalt content of vitamin B_{12}, it thus appears that the added cobalt is utilized by the microorganism, and that only 7–17% of the cobalt that was incorporated in the radioactive vitamin originated in the raw broth. This finding that bivalent cobalt ions can be utilized by microorganism is in accord with the observation (Hendlin and Ruger, *Science*, **111**, 541 [1950]) that addition of cobalt salt to synthetic media increases the yields of B_{12}, and with the report (Abelson and Darby, *Science*, **110**, 566 [1949]) that a radioactive compound, presumably B_{12}, can be isolated from the feces of sheep fed inorganic cobalt 56.

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Operation Lamprey

This is to report an observation on lampreys that strikes me as being interesting rather than significant, but unparalleled in the field of general zoology. As is commonly known, the parasitic lampreys attack fish, rasp a hole in the flesh, and suck out the blood and tissue juices. If the lamprey attaches itself on the thick dorsal body wall the wound ordinarily heals after the lamprey releases its victim, and the fish usually survives. A distinctive sort of scar results. If, however, the attachment is made to the ventral body wall, the wound in most cases penetrates into the body cavity. This circumstance is almost always promptly fatal to the fish. In terms of surgery, the lamprey has performed a crude sort of laparotomy.

Clarence H. Kennedy, of the Department of Zoology and Entomology here, has told me of an observation he made several years ago on an 18-inch pike, *Esox reticulatus* Le Sueur or *E. lucius* L., which he had taken from Cayuga Lake, near Ithaca, New York. This pike had been attacked by a lamprey, presumably *Petromyzon marinus* (land-locked), about an inch directly craniad to the anus on the midventral line. The wound had been formed through the body wall, mesentery, and intestine and had then healed in such a manner as to form an opening into the gut without exposing the peritoneal cavity. The open character of the wound caused it to act as the outlet of the intestine and the original anus now appeared to be nonfunctional. Here, then is an example of a piece of difficult surgery being performed by a member of the most primitive class of vertebrates on an individual several "notches" advanced phylogenetically. Obviously, this was a case of accidental and unintentional colostomy that was startling to the pike if not to the lamprey.

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Book Reviews

Security, Loyalty, and Science. Walter Gellhorn. Ithaca, N. Y.: Cornell Univ. Press, 1950. 300 pp. $3.00.

It would be naïve to expect members of Congress to read this review, but, in the remote possibility that one of them may pick up this issue of SCIENCE and get to this page, I recommend the book for his consideration. As for the regular customers of this journal, Professor Gellhorn's contribution cannot be too strongly recommended to all those concerned not only with the state of science today but with the state of the Union. Some of the facts assembled in this book are so bizarre as to make every intelligent layman wonder that some scientists of force and originality still remain in government service. That they have done so is no fault of military intelligence or the House Committee *of* Un-American Activities. To what extent these two agencies have reduced our scientific advantage is, of course, difficult to determine.

It is said that, in order to avoid the unpleasantness resulting from the interruption of their research, a number of government scientists are seriously considering joining the Communist Party. They reason if they join "the Party" and then resign they become "ex-Communists," and practically everybody knows that to some public officials there is no one more loyal, more honorable, or more patriotic than an ex-Communist—except possibly an ex-Nazi. The idea may perhaps have something to recommend it but it won't work, for they'd still be scientists, and practically everybody knows that to some public officials there is no one more cunning, more treacherous, or more suspect than a scientist—except possibly a social scientist. So low a fellow is he that many states have seen fit to pass special laws concerning him and to require special oaths from him. These also apply to all his nonscientific academic associates, except college presidents. The latter, so I hear, can mingle with anyone and be free of guilt by association. One prexy has been heard to object to this type of class distinction (based on immunological criteria) on the grounds that it is very undemocratic and discriminates against college presidents. His name cannot be revealed for reasons of national security.

Another deterrent, so it is claimed, that keeps strong research men away from government laboratories is the overclassification of the work. This prevents the investigator from publishing—or, to be more correct—submitting for publication, the results of his research. Actually this is a boon to the editors of our more critical scientific journals. Nevertheless, the military and the AEC should avoid classifying as "secret" such data as are found in the first editions of *Kirkes' Physiology* (1848) and the *Handbook of Chemistry and Physics* (1914). Also, if they haven't got around to it yet, "Mothersill's" seasickness remedy should be removed from the "restricted" category.

Overclassification may also be hazardous to health. There is a rumor concerning a scientist who, while working in a military laboratory, wrote a report which was promptly classified as "secret." Now, he was only cleared to receive "confidential" material, and one day when he went to the laboratory's library to request a copy of his report, it was refused him as he was not cleared to receive "secret" material. This caused him no end of confusion and anxiety and he had to be placed in an asylum. Incidentally, he was a psychoanalyst. I am quite certain that all men of civilized feelings will agree that that is no way to treat an investigator, even a psychoanalyst.

And so those are some of the thoughts that come to mind while reading Professor Gellhorn's excellent and very serious survey of the sad situation of science and scientists, not only in our government laboratories, but also in many of our universities. That so important a book about so serious a situation should provoke in this reviewer whimsical and even incongruous thoughts is not intended as a detraction of its excellence. The undersigned, having had some contact and a little experience with the military, has come to the conclusion that this attitude is our best defense and probably our most effective offense. Remember what happened to that poor psychoanalyst!

DAVID B. TYLER

Bel Air, Maryland

Contributions to Mathematical Statistics. R. A. Fisher. New York: Wiley; London: Chapman & Hall, 1950. 655 pp. $7.50.

This volume is the twelfth of the "Wiley Publications in Statistics," edited by W. A. Shewhart, of the Bell Telephone Laboratories. It provides the scientist with a compendium of Fisher's 42 most important papers in their original familiar form, thanks to the industrial uses of photography. Each paper is preceded by a note by the author; also included are a biography of Fisher written by P. C. Mahalanobis, F.R.S., Statistical Adviser to the Cabinet of India, and an excellent index contributed by John W. Tukey, of Princeton. Errors and misprints in the original papers are corrected, and there are occasional modifications of notation for the sake of uniformity. Publication of his collected works, during the author's lifetime, while he is still vigorously turning out statistical research of undiminished quality, canonizes him while he yet lives. May there be a second edition with many additions!

A curious omission may be observed—an omission not chargeable to the author or publisher: the first paper (No. 1), "On the Probable Error of a Coefficient of Correlation Deduced from a Small Sample," *Metron*, 1921, is not there. The author's note is there, but not the paper itself, permission for republication

having been withheld by the established policy of *Metron*.

Because of the unusual character of the book—full-scale reproductions of the original articles—the page size is dictated by that of the *Transactions of the Royal Society*. Indeed, in this journal (Series B, 1922) appeared his famous paper, "On the Methodological Foundations of Theoretical Statistics," which was in the words of Fisher himself, "the first large-scale attack on the problem of estimation."

Space will not permit a rehearsal of the table of contents, which would almost be a list of the most important steps in the building of statistical methodology: design of experiment, theory of estimation, testing of hypotheses, method of maximum likelihood, fiducial probability. Statisticians all over the world will welcome the publication of this book, as it puts the most important contributions of Professor Fisher within reach, in their original familiar format.

The aim of theoretical statistics is better data, detection and elimination of biases and systematic errors, and experiments planned so as to extract the maximum amount of information per unit cost. Such achievement requires a demonstrable index of the precision attained in the experiment, and of the risks of the probable inferences that may be drawn. More important, it requires also the ability to plan the experiment ahead of time so as to attain the desired precision, but no more, in order to conserve funds for other worthy experiments. Correct planning and interpretation require use of the theory of probability, and it is largely from Fisher that scientists have learned this way of thinking, thanks to his two popular books, *Statistical Methods for Research Workers* (1925) and *Design of Experiment* (1935), known to practically all workers in agricultural science, pharmacology, toxicology, biology, and nutrition. With but little modification, the same methods are equally powerful and as necessary for realization of maximum economy and reliability in industrial experimentation, testing of materials, interlaboratory tests, testing of machines, and in physical and chemical measurements.

The use of probability in the hands of Fisher and many others has built a statistical method, and has rescued statistical work from the dry compilation and graduation of figures. Statistical data are now collected and interpreted as *intelligence*, a contribution to knowledge, and a basis for action.

A few words on statistical education may be properly placed in this review. Until recently, books on theoretical statistics were rare. To study the theory of statistics it was necessary to peruse many articles in journals, mostly difficult, and in divers notations, or to be so fortunate as to work with one of the few masters of the subject. Statistical education was thus accessible only in the higher levels of research. During the past five years, however, this situation has started to change. A number of excellent teachable books have appeared, containing authoritative exposition of theory and application, not only in the Wiley series, but from other publishers as well. Statistical education is reaching down into the graduate and undergraduate levels, to the research worker, and even to the administrator. There is no longer an excuse for runs of inefficient tests and experiments, or for runs of unwarranted inferences from experimental data.

W. Edwards Deming

Bureau of the Budget

Les Ultravirus des Maladies Humaines, 2 vols. 2nd ed. C. Levaditi and P. Lepine. Paris, France: Librairie Maloine. 1948. 1,907 pp.

Rapid and continuous progress in our knowledge of the submicroscopic forms of life was made during the decade between the appearance of *Traite des Ultravirus* and the present volumes. The most outstanding contributing factors were the developments and improvements of technique for virus research rather than the discovery of new clinical entities. The relatively compact air-driven supercentrifuge, refrigerated if desired, supplanted to a marked degree the earlier huge, cumbersome oil-driven instruments; refinements in the procedures of tissue culture and the availability of electron microscopes all played major roles.

A wealth of material and an extensive literature forced the deletion of the Rickettsiae from the present edition. Although the rickettsial diseases of man have much in common with certain virus diseases, rickettsial infections are readily distinguishable from virus infections, and the decision to limit these volumes to the human viruses was a wise one.

The authors were aided by 26 collaborators, all specialists in the areas delegated to them. There are 32 main subjects or sections. Between the initial section, entitled "General Considerations and Methods for Investigation," the contents of which are handled in a superb manner, and the final section, captioned "Laboratory Diagnostic Methods," one finds an exhaustive coverage of the important virus diseases and adequate mention of the less common maladies of virus etiology. There are 368 figures and 3 colored plates. The editing has been done with great care to ensure retention of the writer's personality in each instance. The bibliography for each section is encyclopedic. Full recognition is given to the literature in English, German, and other foreign languages. Scientists, particularly my English-speaking colleagues, might well profit by this familiarity with, and acknowledgment of, the contributions of others.

Unfortunately the authors' task is not complete. It will be necessary to publish the third edition of this monumental work promptly so as to keep abreast of progress in this field. In the meantime, the present edition should be in every laboratory and research institution where the infectious diseases are under consideration.

Malcolm H. Soule

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Verstandliche Elemente der Wellenmechanik: Photonen, Freie Elektronen, Einelektronige Atome, Teil I. Karl Jellinek. Basel, Switzerland: Wepf & Co., 1950. 304 pp. Sw. fr. 34.

The aim of this book, written by a well-known German physical chemist, is to present wave mechanics in a form understandable to other chemists and also to experimental physicists. To do this the author develops his own interpretation of wave mechanical formalism—an interpretation which stands in direct contradiction with present accepted ideas. Jellinek claims, for example, that a simple understanding of wave mechanics can be achieved by accepting atomic structure of light ether, and preaches that the coordinates and momenta of a moving particle always possess well-defined values, and that the uncertainty principle is only describing the imperfection of our measurements. It is quite possible that some experimentalists, for whom the book is intended, will find it easier to "understand" Professor Jellinek's wave mechanics than the somewhat involved gnosiological form developed by Bohr, Heisenberg, and others. But this will be, in fact, only a very gross misunderstanding!

The technical part of the book, involving mathematical treatment of the harmonic oscillator, rotator, hydrogen atom, and potential barrier (discussion of the helium atom, alkali atoms, and diatomic molecules being reserved for the second volume) is very nicely written, and can be of really great help to students without previous experience in the methods of theoretical physics.

GEORGE GAMOW

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The Properties of Metallic Materials at Low Temperatures, Vol. 1. Monograph on metallic materials published under the authority of The Royal Aeronautical Society. P. Litherland Teed. New York: Wiley, 1950. $3.50.

This monograph by P. Litherland Teed is a survey and compilation of data pertaining to experiments on properties of metals at low temperature and includes rather extensive references to work that has been done in this field. The book seems directed toward the possible use of such materials in aircraft, but the same principles are applicable in other uses.

Data are included on the effect of low temperatures on mechanical properties (such as tensile and yield strength, endurance limit, elongation, reduction of area, Young's modulus, impact strength, etc.) of aluminum, magnesium, iron, copper, nickel, zinc, tin, lead, and some of their common alloys, as well as on welds, cold-worked and heat-treated metals, and permanent changes in properties caused by short time exposure to low temperature. Also included are some data on electrical resistance at low temperatures of aluminum and copper.

The author critically discusses the material presented and attempts to draw conclusions, some of which are based on admittedly scanty data, regarding the effect of low temperatures on mechanical properties of metals.

The primary contribution of this book lies in the compilation of available data and references on low temperature behavior of metals and alloys. From a somewhat negative viewpoint, it reemphasizes the dearth of such knowledge available to the designer and the need for additional research.

DILLON EVERS

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An Atlas of Human Anatomy. Barry J. Anson. Philadelphia: Saunders, 1950. 518 pp. $11.50.

This excellently illustrated atlas of regional anatomy was prepared by one of the few anatomists in the United States who has done extensive research, in association with clinicians and a group of competent medical artists, on the structure and variations in the human body. The new and informative illustrations made from dissections or osteological specimens depict the observations and anatomical concepts of Dr. Anson and his colleagues.

The inclusion of oblique views or longitudinal sections from certain areas; tabulations of pertinent information such as the cranial fossae with their foramina and the structures traversing each foramen; illustrations for the development of the mesenteries and peritoneal folds; the action of certain muscles or muscle groups, such as the pronators and supinators; and examples of the variations observed in many structures, enhance the usefulness of this book for medical students and particularly for clinicians.

Legends for certain illustrations may appear too lengthy and detailed. They are necessary, however, to clarify the views shown, emphasize the structures illustrated, and inform the reader of structures which have been removed or displaced from their normal relations. In consideration of the present tendency to use the Anglicized forms of anatomical terms, it may be confusing to the reader to find most of the terms in the strict Latinized (B.N.A.) form although some illustrations are labeled entirely with Anglicized terms. A few minor errors are present, but they are far outweighed by the excellent qualities of this atlas.

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News and Notes

Scientists in the News

George Batchelor, of Cambridge University, will spend a month working with **C. C. Lin** at MIT during late March and April, and will give a series of lectures on the applications of similarity theory on turbulence.

E. U. Condon, director of the National Bureau of Standards, has been elected president of the Philosophical Society of Washington. The Philosophical Society, founded in 1871, is the oldest Washington organization devoted to the promotion of science, and its first president was Joseph Henry, renowned physicist. Dr. Condon was recently awarded honorary D.Sc. degrees by the University of Delhi and the New Mexico School of Mines. The Royal Swedish Academy of Engineering Sciences has elected him a corresponding member in recognition of his contributions to science and administration in science.

Clarence E. de la Chapelle has been named director of the new division of affiliated and regional hospitals of the New York University-Bellevue Medical Center. He will coordinate the teaching program carried forward at 20 hospitals now affiliated with the center for training undergraduate medical students and physicians taking postgraduate studies. Dr. de la Chapelle was professor of medicine and associate dean of New York University Post-Graduate Medical School in 1948, after serving on the faculty of New York University College of Medicine for 25 years.

Charles G. Ferrari, who was in charge of the Chemical Research Division of General Mills, and later assistant to the vice president in charge of research for Standard Brands, has joined the J. R. Short Milling Company as technical director. Dr. Ferrari will also supervise the Short control laboratories.

George Gross Finney, who is associated with the Johns Hopkins, the Union Memorial, and Women's Hospitals in Baltimore and is professor of surgery in the Johns Hopkins Medical School, has been elected a charter trustee of Princeton University.

Two of Chicago Natural History Museum's veteran curators, **William J. Gerhard,** curator of insects, and **Paul C. Standley,** curator of the herbarium, have been retired from active duty. Both are desirous of continuing scientific research, and each has been appointed curator emeritus in his division. Dr. Gerhard is a veteran of nearly 50 years' service on the museum staff —the longest service record of any staff member now living. He joined the staff in 1901. Dr. Standley, as curator emeritus, will reside in Honduras and there will continue for the museum his Central American plant studies, which have been his principal activity on expeditions for several years past. He joined the staff of the museum in 1928. The vacancy in the curatorship of the division of insects has been filled by appointment of **Rupert L. Wenzel,** who first became associated with the museum as a volunteer assistant in the division of insects in 1934 while still a student. He was appointed assistant curator of insects in 1940. **Henry S. Dybas,** assistant curator of insects, has been promoted to associate curator. **Julian A. Steyermark** has been appointed curator of the herbarium to succeed Dr. Standley.

Ralph K. Hurch, 65, a graduate of the University of Illinois in 1908 and staff member since 1911, will receive the Ross Coffin Purdy award for "the most valuable contribution to ceramic technical literature during 1949" at the April meeting of The American Ceramic Society. This was a paper on "The Development of a Porcelain Vacuum Tube," a development that makes ultra-high-voltage x-ray machines possible.

E. Ross Jenney, formerly with the Division of Tuberculosis, USPHS, has gone to Java, where he is at present medical director of the Special Technical and Economic Mission to Indonesia (ECA). This unit, with headquarters at Djararta, is engaged in the rehabilitation of public health services, with particular emphasis on malaria and the improvement of rural public health.

Frederick G. Keyes, chairman of the Department of Chemistry of MIT for 23 years, has been named vice president and director of Alfred Bicknell Associates. Dr. Keyes' most notable scientific contributions have been in the fields of thermodynamic properties of matter, kinetic theory of matter, and applications of thermodynamics to problems of chemical equilibria.

Kenneth A. Koerber has been appointed chief industrial physician for Sharp & Dohme, Philadelphia. Just prior to his association with Sharp & Dohme, Dr. Koerber held a civilian post with the U. S. Army Hospital at Fort Eustis, Va. His previous experience in industrial medicine includes service as medical director of Cramp Shipbuilding Company and the Electric Storage Battery Company. He has also been associated with the National Lead Company and was chief of medical services at the Brookhaven National Laboratory.

Everett S. Lee has been appointed editor of the *General Electric Review,* monthly engineering magazine published by General Electric. Mr. Lee succeeds **Edward C. Sanders,** who has retired.

Wayne University College of Medicine has announced the appointment of two assistant professors, **William G. McCullough,** in the field of microbiology, and **Harper K. Hellems,** in the field of medicine. Professor McCullough was formerly in the medical bacteriology department at the University of Michigan. Dr. Hellems has served on the staffs of the West Rox-

bury Veterans Hospital and the Peter Bent Brigham Hospital in Massachusetts.

Charles F. McKhann has resigned as professor of pediatrics of the School of Medicine, Western Reserve University, and director of pediatrics in the University Hospitals of Cleveland.

Philip Manson-Bahr has accepted the post of director of the London Cinchona Bureau. He succeeds the late **Charles A. Bentley.**

Robert J. Meltzer has joined Bausch & Lomb Optical Company's Scientific Bureau. Before taking his doctorate in physics at Johns Hopkins, he served for two years as a research assistant for the armed services' guided missiles program at the Naval Research Laboratories and at Massachusetts Institute of Technology.

Gordon W. Newell has joined Stanford Research Institute's Department of Applied Biology as senior biochemist. Dr. Newell was formerly with the Wallace & Tiernan Company, of Newark, N. J.

William Barclay Parsons, professor of clinical surgery at the College of Physicians and Surgeons, was elected president of the New York Academy of Medicine for a term of two years, succeeding **Benjamin P. Watson,** who was elected a trustee. **Henry Alsop Riley** was elected vice president, and **Shepard Krech** treasurer, of the Academy.

J. J. Paul has resigned his position with the Wisconsin Alumni Research Foundation to accept a position as assistant professor of entomology at the University of Georgia.

Sol Pincus, recently appointed consultant to the World Health Organization, has spent two months studying sanitation problems in Santiago, Chile, working with the Chilean Ministry of Health. In 1949 he was chief of the Environmental Sanitation Section of WHO, with headquarters at Geneva.

Donald K. Tressler, formerly consulting food technologist and head of Donald K. Tressler and Associates, Westport, Conn., has been appointed scientific director, Quartermaster Food and Container Institute for the Armed Forces.

Neely Turner, entomologist at the Connecticut Agricultural Experiment Station, is spending six months in England as an exchange scientist on the staff of the Rothamsted Experimental Station. He will devote his half year of research abroad to the study of insecticides, working in Rothamsted's Department of Insecticides and Fungicides. **A. H. McIntosh** is returning to Rothamsted after a year on the staff of the Connecticut Station, under the exchange agreement between the two institutions. While in New Haven, Dr. McIntosh devoted himself to a study of the particle size of chemical compounds and the ways in which this factor affects their toxicity as insecticides.

Grants

The **American Petroleum Institute** has launched an intensive study, to be conducted by the University of California, to probe the role of marine sediments in creating crude oil. The annual cost of the study will be approximately $123,000, and the work is expected to cover at least three years. Actual field work will be done by the Scripps Institution, under the directorship of F. P. Shepard; the Woods Hole Oceanographic Institution has agreed to assist Scripps in the investigation, and Gulf Coast institutions also are under consideration as possible participants.

A grant of $4,500 has been given to the **National Science Teachers Association** to make a two-year study of science facilities in the secondary schools. The most recent Federal report on this subject, published in 1927, is out of print, as well as being out of date. John S. Richardson, professor of science education at Ohio State, will be director of the study and editor of the reports that will be published. Ralph W. Lefler, president of the NSTA and professor of physics at Purdue, is a member of the committee.

Recent gifts to the **University of Texas Medical Branch,** Galveston, for the support of research include the following: $3,000 from Smith, Kline & French Laboratories, for research under the direction of Clarence S. Livingood, professor of dermatology and syphilology; $6,600 from the W. K. Kellogg Foundation for participation in a curriculum-planning program for nurses at the University of Chicago; $1,300 from the American Heart Association for research under the direction of C. E. Hall of the Department of Physiology; and $1,800 from the American Cancer Society for research under the direction of Charles M. Pomerat, of the Tissue Culture Laboratory.

Northwestern University's School of Medicine will investigate effects of atomic radiation on bone marrow through a grant of $22,275 from the USAF. The two-year program will be directed by Howard L. Alt, with the assistance of John A. D. Cooper.

Applications for grants-in-aid of chemical research from the **Cyrus M. Warren Fund** of the American Academy of Arts and Sciences should be received by the chairman of the committee, Frederick G. Keyes, MIT, Cambridge 39, Mass., not later than *April 20.* No funds are awarded for salaries.

The George Washington University has received a one-year grant of $17,671 for research in arterial injection of nitrogen mustard to control cancer from the **Alexander and Margaret Stewart Fund.** The studies will be made by Jeanne Bateman, formerly of New York College of Medicine.

The Committee on International Exchange of Persons, 2101 Constitution Ave., Washington 25, D. C., will answer inquiries regarding professional qualifications of foreign scholars who wish to teach in American universities under the **Fulbright program** during the academic year 1951–52.

Fellowships

The **Institute for Numerical Analysis** of the National Bureau of Standards is offering two types of appointments for study at the University of California at Los Angeles: summer studentships lasting ten weeks, and thesis fellowships to graduate students in pure and applied mathematics for one year. Application should be made before *March 1* to J. H. Curtiss, 405 Hilgard Ave., Los Angeles 24.

General Electric Science Fellowships for high school teachers will be offered this summer at Union College and at Case Institute of Technology. Those at Union (July 7–August 10) will be awarded to 50 teachers in 13 Northeastern states and the District of Columbia and are applicable in the fields of chemistry and physics. Completed applications must be received by *April 1* by Committee on GE Fellowships, Union College, Schenectady 8, N. Y. The fellowships at Case, awarded in recognition of excellence in the teaching of high-school physics, are open to teachers in 12 Midwestern states. Applications for the six-week program, which will extend from June 25 to August 3, must be sent to Dr. Elmer Hutchisson, Case Institute of Technology, Cleveland 6, Ohio, by *April 14*.

Academies of science and similar groups of professional scientists in 23 states are assuring further education for promising high-school science students by holding state **Science Talent Searches** concurrently with the Tenth Annual Science Talent Search, conducted by Science Clubs of America and administered by Science Service.

Boys and girls who will graduate in 1951 from public, private, or parochial secondary schools in Connecticut, District of Columbia, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Massachusetts, Minnesota, Montana, New Hampshire, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, or Wisconsin will have a double chance at scholarships and other financial assistance for a college education because, when they enter the national contest for Westinghouse Science Scholarships, they will automatically enter their own state Science Talent Search.

Committees of scientists will receive all entries for students from their state, after the national competition has been judged, and will then judge which boys and girls show greatest talent for science as indicated by a three-hour science aptitude examination, scholastic record, recommendations by the faculty, and a report of about 1,000 words on "My Scientific Project" as submitted by each entrant. Personal interviews will be arranged in many of the states before final selections are made.

State Science Talent Searches originated in 1946 when academies of science in Tennessee and Virginia first worked out the plan with Science Clubs of America. Since then the plan has been widely adopted and has accounted for the education of hundreds of boys and girls.

Where funds are not available outright from their own treasuries or from state industries, the academies have worked out systems of recommendation that make scholarship assistance available from state colleges, universities, and technical schools. In one state in 1950, the 28 seniors chosen for state honors were offered $33,000 worth of scholarships or other financial assistance to make college possible for those who could not otherwise afford it.

The Tenth Annual Science Talent Search has been completed, and the winners will come to Washington for final rewards and awards March 1–5. Any state academy of science wishing to arrange a State Science Talent Search for 1951 should write to Margaret E. Patterson, Science Clubs of America, 1719 N St., N.W., Washington 6, D. C.

Applications for the **Science Teachers Fellowships** provided by a grant from the Westinghouse Educational Foundation, for high-school science teachers must be made by *April 1* to Professor Francis W. Sears, MIT, Cambridge 39. The six-week summer program is open to science teachers in all U. S. high schools, and will be directed by Professor Sears.

Colleges and Universities

Unesco's new edition of ***Study Abroad*** lists more than 30,000 opportunities for foreign study, of which 12,750 are in the U. S. Published by Columbia University Press, Volume III of this annual guide sells for $1.25. The **Institute of International Education,** 2 W. 45th St., New York 19, is distributing a pamphlet listing summer sessions to be held abroad this year. This list gives data regarding the general nature of the courses, applications, credit, living arrangements, dates, and similar information.

A three-week seminar for scholars from the United States, Canada, England, and Israel, on the place of Israel in world affairs, will be held at **Katznelson Institute,** north of Tel Aviv, July 15–August 5. The second **New York University** workshop for 100 American university students will be held July 7–August 18 at the same institute. The workshop gives intensive courses in Israeli life to American graduate and undergraduate students, who pay for the instruction and are allowed credit for it in their home universities.

The **American College of Physicians** has announced postgraduate courses to be given between now and mid-June at the University of Oregon Medical School (March 19–23); Wayne University College of Medicine (March 26–31); Pittsburgh School of Medicine (April 24–28); Pennsylvania Hospital (May 7–12); New York University-Bellevue Medical Center (May 21–25); and Boston University School of Medicine (June 4–8). All registrations must be made through the executive offices of the college, 4200 Pine St., Philadelphia 4.

The first two of a series of public seminars on "Blood Cells and Plasma Proteins: Their State in Nature" were held this month at **Harvard** under the sponsorship of the Laboratory of Physical Chemistry Related to Medicine and Public Health. Mem-

bers of the university laboratory staff and visiting specialists will conduct seven more seminars on Thursday afternoons during March and April.

Among the special courses offered by **Massachusetts Institute of Technology** this summer are a seminar on Applications of Probability Methods to Problems in Analysis and a special course in probability, both conducted by Mark Kac, professor of mathematics and engineering physics at Cornell (June 11–July 20); Acoustics in Testing and Processing, under Richard H. Bolt and Theodor F. Hueter, of the Acoustics Laboratory (June 18–22); training programs in instrumental analysis, conducted by David N. Hume and Lockart B. Rogers, of the MIT Department of Chemistry (July 9–13 and July 16–20); and techniques and applications of infrared spectroscopy, directed by Richard Lord, MIT Spectroscopy Laboratory, and Foil A. Miller, Spectroscopy Laboratory, Mellon Institute (July 9–16). Applications for all courses should be addressed to Professor Walter H. Gale, Director of the Summer Session, Room 3-107, MIT, Cambridge 39, Mass.

Miscellaneous

The first issue of *Serial Titles Newly Received,* to be published by the Library of Congress, will carry a January date line. Initially, only titles received by the Library itself will be included, but eventually the list will be expanded. New titles received by the Library of Congress are alone expected to total more than 20,000 this year. The annual subscription price will depend upon the number of advance subscriptions received by *March 1.*

At the fifth Annual Award Dinner of the **Viking Fund,** held in honor of the three outstanding anthropologists chosen each year by their respective societies as Viking Fund Medalists, it was announced that the Viking Fund would be renamed the Wenner-Gren Foundation for Anthropological Research, in honor of Axel L. Wenner-Gren, who created and endowed the Viking Fund in 1941. Clyde Kay Kluckhohn, of Harvard, was Medalist in General Anthropology, chosen by the American Anthropological Association; Emil Walter Haury, University of Arizona, was Medalist in Archaeology for The Society for American Archaeology; and Wilton Marion Krogman, University of Pennsylvania, Medalist in Physical Anthropology, selected by the American Association of Physical Anthropologists.

More than 100 laboratory and field training courses are being offered for 1951 by the **Public Health Service.** The emphasis in all courses, most of which are given by the Communicable Disease Center, is on training personnel to maintain health services in defense and mobilization. Application forms for laboratory refresher courses may be obtained from Laboratory Services, Communicable Disease Center, Box 185, Chamblee, Ga.; for field training courses from Training Services, Communicable Disease Center, 50 Seventh St., N.W., Atlanta 5, Ga.; and for the ten special courses given at the Environmental Health Center, from the Chief, Training Section, 1014 Broadway, Cincinnati 2, Ohio.

The **Universities Federation for Animal Welfare** is asking for suggestions for the improvement of the UFAW Handbook on the Care and Management of Laboratory Animals, last issued in 1947. The address of the federation is 284 Regent's Park, Finchley, London, N. 3.

Youth Argosy, an educational nonprofit organization, is offering this year, as it has since May 1948, low-cost travel to those with the "serious purpose of broadening cultural and spiritual horizons and building friendly relations with young people of all nations, creeds, and races." Trips include visits to Africa, South America, Mexico, the Holy Land, walking tours in Arctic Lapland, flights around the world, or short tours in Europe. For further information, write to Youth Argosy, Northfield, Mass.

Under the auspices of **Unesco,** volunteers in Service Civil International may help to rebuild towns from Greece to Lapland, Algeria to Japan. Volunteers pay their own expenses, and a small amount of board in the work camp, live in tents, and do their own cooking. For further information write to Reconstruction Department, Unesco, 19 Ave. Kleber, Paris, France.

Exercise Mukluk, a winter clothing and survival equipment test, is being carried out this month by the RCAF in the Fort Nelson, B. C. area, and Cambridge Bay, in the Arctic Islands. Both RAF and RCAF equipment will be tested. The Canadian Army-RCAF joint tactical exercise this winter, **Sun Dog Two,** is being held in an area north of Fort Churchill. Sun Dog Two is a small exercise designed to provide training to meet the ordinary problems of airborne, air-transported winter operations in the Arctic.

Under the **Technical Assistance Programme** of Unesco, candidates are being sought for various scientific posts in Ceylon, Ecuador, Indonesia, Iraq, Lebanon, Liberia, Mexico, Pakistan, and Thailand. Applications should be directed immediately to the Recruiting Officer, Bureau of Personnel, Unesco, 19 Ave. Kleber, Paris 16e, France.

At the request of the Award Committee we wish to repeat the notice that appeared in SCIENCE on January 26 (p. 109)—namely, that nominations for the **Theobald Smith Award** must be received before *March 15.* Nominations may be made by Fellows of the AAAS and should be sent to the secretary of the Subsection on Medicine, Dr. Gordon K. Moe, Department of Physiology, State University of New York Medical Center, Syracuse. They should be accompanied by full information concerning the nominee's personality, training, and research work. Any investigator who was less than thirty-five years of age on January 1, 1950, and is a citizen of the United States is eligible. The secretary requests that all data be submitted in triplicate.

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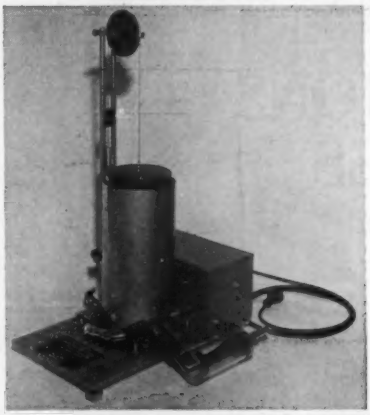

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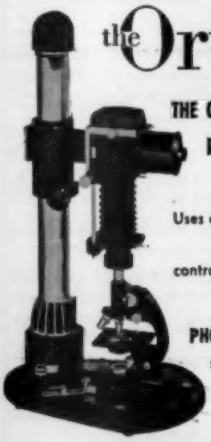

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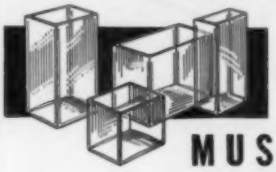

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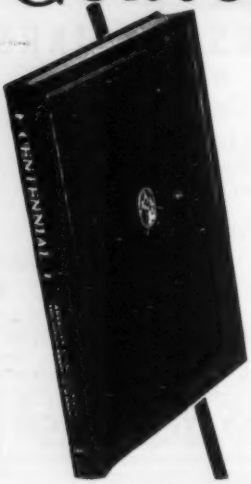

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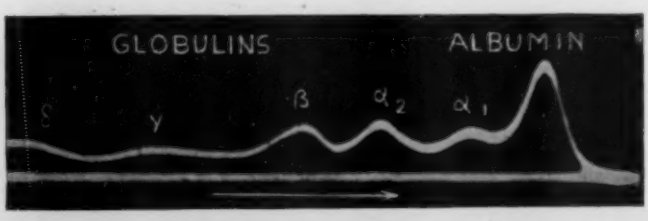

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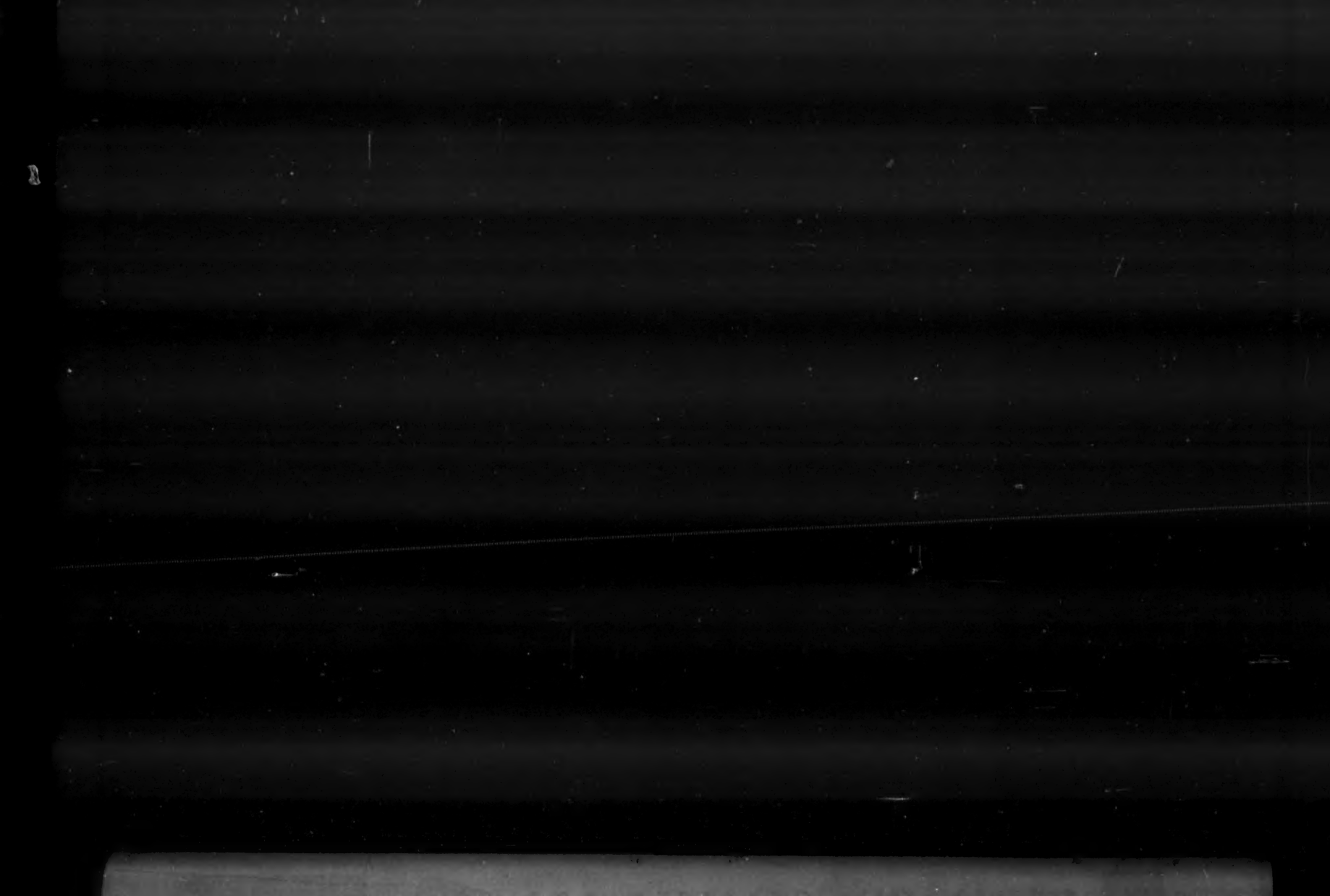
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